RAILROAD GAZETTE

FRIDAY, MAY 31.

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Contributions.

Rail Joints.

TO THE EDITOR OF THE RAILROAD GAZETTE:

A recent article in your paper and also one in the *Engineering News* seem to convey the idea that so far as fish plates for joint fastenings are concerned, the one adopted by the "West Shore," viz.: the six-hole, three-tie pattern, is about perfect. The writers of those articles seemed so well pleased with the results of their observations that it is too bad to say anything of a disparaging nature, for as they leave the matter nothing more seems to be needed in the line of improving the joint fastening. The growth of the joint fastening seems to be somewhat stunted just now, and it is difficult to tell in which direction it will start next. Perhaps the plates should be extended along the rail indefinitely and more holes introduced. A further extension of the plates *might* assist the joint. *Perhaps* the "Fisher Bridge" joint should extend over more ties. The bridged joint is fully equal to the "West Shore."

But in both the above cases the rail ends are from 0 to ¼ of an inch apart. There seems to be no *bridge* for the wheels to pass over this opening between the rails. *There* is where the mischief lies, and no rail joint, either bridged or fished, can be more than a partial success until the passing wheels have solid metal to roll on from rail to rail.

Go to the men whose daily duty it is to raise low joints, and ask them if the "West Shore" fastening has actually deprived them of work. Ask the supervisors who keep run of such matters if 60 per cent. of all track work is spent in raising low joints or low centres. When the track foreman can honestly tell you that he raises no more joints than centres in all his summer's work, then and not till then is the joint up to the standard.

A. D. BLACKINTON.

Mica as a Lubricant.

NEW YORK, May 24, 1889.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I do not want you to think that I am endeavoring to promote any scheme of mine in addressing you, but I cannot resist saying that the use of mica, ground by the cyclone pulverizer, as a lubricant, is assuming very great importance in connection with railways. The managers of a cyclone plant, which has been erected at Denver for the New Mexico Mica Mining Co., have ground mica to such an excessive fineness that the tests of the material as a lubricant have been very successful. A letter, which I have just received from Denver, states that on the Rock Island Road the mica experiment was very satisfactory. They cooled off journals that came in heated, by applying mica, and the agent reports that one which came in very hot was sent forward as soon as the mica lubricant had been applied. The train dispatcher received reports from different stations on the road that it had cooled off and was running all right. The experiments that have been made with mica lubricant and mica dope have been successful. The one was made with crude oil and mica, and the other with mica and the residuum from the wells, being a very much cheaper grade of oil. The officials of the Union Pacific and of the Denver & Fort Worth roads have applied for the privilege of a test.

It will be curious if this singular mineral should be found to be a lubricant, to serve so useful a purpose as that of a substitute for that crudest of devices, a huge clot of waste saturated with oil. If you are desirous of pursuing this matter further, Mr. S. M. Allen, at Denver, would no doubt furnish further particulars. ERASTUS WIMAN.

Alloys for Bearing Metals.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I have found most desirable for driving-box linings 1 lb. of tin to 8 lbs. Lake copper or bolt copper. I have found by experience that Baltimore and also the Arizona coppers have something in their nature that injures them for bearing purposes. For connecting rod brasses the metal should be a little harder and I have found that one pound of tin to every 6½ pounds of copper makes the best connecting rod bearing or high speed bearing.

Of course you must know there is a great deal in the smelting of the metal; it should be melted at the lowest possible heat. My method is to weigh my copper and tin, have the crucible clean, put the copper in the pot and the pot in the furnace and heat it till it becomes a very light red. Then I put in a pound or two pounds of tin, that will help the copper to melt. I am always careful not to let the furnace get any hotter than it is when I put the first part of the tin in. When the copper is all melted I put the rest of the tin, in and if making driving box brasses add one ounce of zinc for every eight pounds of copper, and if connecting rod brasses, three-quarters of an ounce of zinc for every 6½ lbs. of copper. The zinc is used for a flux to make the castings sound. It assists the copper and tin to amalgamate. To put the zinc in the crucible use a long jawed pair of tongs, warm the zinc in the furnace, and then plunge it to the bottom of the pot and stir well. The most particular part is the pouring of the mold. It should be very clean, as any loose sand that may remain in the mold will float up with the metal, and perhaps enter and join with the metal; or anyway it will make a bad skin on the casting that will dull the tools, and if you don't take a very deep chip you are apt to leave a fine mixture of sand and metal, imperceptible to the eye, that will cause friction in the journal. Be very careful not to pour the metal too hot, for it will expand in cooling and leave the casting spongy. The metal should not be poured until a skin forms on the top of the pot after it has been taken out of the furnace. But don't let it sit too long without stirring it. I have tried all of the patent bearing metals on the market, but I believe there is nothing beats this for good service: For driving brasses:

Copper	8 lbs.
Tin	1 lb.
Zinc	1 oz.

For connecting rod brasses:

Copper	6½ lbs.
Tin	1 lb.
Zinc	¾ oz.

C.

English Practice in Block Signaling.

LONDON, May 7, 1889.

TO THE EDITOR OF THE RAILROAD GAZETTE:

A correspondent in your issue of March 15 asks a very pertinent question as to English practice with regard to what we call block working, viz., whether a train has to have a space always kept between it and the next following train in the rear. So little is generally known about this practice, the most important, in my opinion, of all precautions for safety (except that of a continuous brake), that I venture to describe English methods at some length at the risk of repeating details known to American railroad men.

Each station where there are sidings is generally provided here with four outdoor signals, which are always now of semaphore form. They are (1) distant, (2) home, (3 starting, (4) advanced starting. (Intermediate stations or signal boxes, where no sidings exist, often have no starting or advanced signal.)

The distant alone may be considered as a repeater of the home signal. It may be passed when at danger, and has a wedge-shaped notch cut out of it to distinguish it by day. All the others are absolute stop signals. The "home" protects the station yard, and is always placed at the rear of the platform at which trains pull up; the "starting" shows the engineer who has pulled up (stopped at the station), whether he may start, *i. e.*, whether the section ahead is clear; the "advanced starting" demands somewhat more explanation, which may be given more clearly when we have examined the actual progress of a train.

Take first the ordinary working on the principal railways. Three block stations shown in cut are A, B and C. A stopping train is about to leave A and the line is clear throughout. The signalman at A asks, by wire, of B, "Can you admit the train?" B answers yes, by the same number of beats on the bell. This operation is termed giving and accepting the "Be ready" electric signal. The signalman at A lowers his advanced and starting signals and then informs the signalman at B that the train has left A. On receipt of this notice, called the "Train entering section" electric signal, B proceeds to give the "be ready" to C, and so on. If C accepts this "be ready," B lowers his advanced, his starting, his home and his distant signals, and as soon as the train leaves his station, gives on the wire the "train entering section" signal to C, and so on.

It will be observed that the lowering of the outdoor signals at each station is thus morally controlled by the signalman in the next box in advance, although, of course, physically they are controlled by the signalman on the spot. Thus A lowers no signal without permission from B, nor B without permission from C, and so on. Practically, thus the section from 1 *a* to 2 *b* is considered and spoken of as B's section, though its entrance signals are physically worked by A. All out-door signals are put up to danger as soon as the last vehicle with tail-board or tail-lamps complete has passed them. This is the general method of working throughout England. Now we come to varieties of practice.

On the best roads, supposing the first train has left A, and another is waiting to follow, the signalman at B may not electrically "clear back" to A until the last vehicle of the first train has passed the home signal at B (2*b*), at least two or three hundred yards. This is the most complete and satisfactory form of absolute block working and exists in virgin purity only on the Great Northern, Caledonian and one or two other lines.

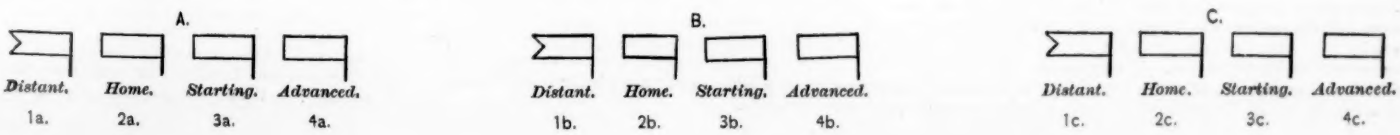
Moreover, on most lines this "clearing back" does not of itself authorize A to send on the next train without having again given the "be ready" signal for it to B, *and having had it accepted by B*. It will be noticed that with the electric, as well as with the outdoor signals, the normal state of the line is thus "block," and A has to *ask* B each time before he allows a train to pass on. This system of working may be termed "absolute outdoor *and* electric block," and practically insures great safety, because two signal men have to make a mistake in order to organize an accident, or at any rate one signalman has to make three separate mistakes. No system can absolutely overcome human fallibility, but this comes near to it. As, however, the long distance which the train had to be past B's home signal before he might clear back was found in practice to cause unnecessary delay, some roads only instruct that the signalman at B may give back "line clear" to A, and may accept A's "be ready" signal as soon as the last vehicle of the first train with tail boards or tail lamps has passed the home signal at B. The disadvantage is this: that, supposing the train breaks down only just at the moment that its last vehicle has passed B's home signal, B may yet "clear back" to A and may accept the "be ready," and thus the driver of the second train has only the thickness of the home signal post (2*b*) to protect him against running into the first train—it being always borne in mind that the distant signal (1*b*) *may be passed when at danger*, being only a repeater to the home signal—while at night, when the risks are greatest, it shows just the same red light as the home.

This disadvantage is aggravated where, as on a few lines, a system of electric working still exists which may be described as "permissive electric and absolute out-door block," viz., where no "be ready" signal is used, and where the signalman at B "clears track" to A immediately that a train arrives, and thereupon A is allowed to send the next train on at once, without giving or receiving acceptance of the "be ready" signal.

To obviate this danger, and at the same time to provide a fairly safe system of working, a compromise has been effected as follows: Should the first train break down so that its rear vehicle is only protected by B's home signal by a short distance, or should a train be pulled up at a platform under similar conditions, and be standing between the home and starting signals, B may give back to A a special electric gong signal, "*section clear; station (or junction) blocked.*" In such a case, on some lines, a green signed ticket is given by the signalman at A to the driver of the second train, who thereby knows that he may proceed to B, but will have to keep his train under such control that he may be able to stop short of any obstacle at B. Instead of the green ticket some lines make the signalman at A show a green flag by day, and a green lamp by night, to the second driver, and warn him verbally after stopping him, dead. This working is only observed for passenger trains (or for one passenger and one goods train), two goods trains being allowed to approach without any warning signal. In fogs this warning system is entirely suspended.

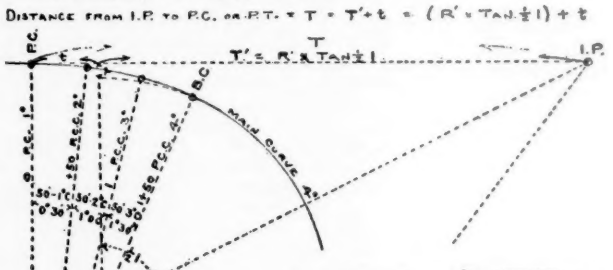
It will be observed that without some elasticity of this sort there would be great delays over long block sections, but there can be no question that the Great Northern plan of putting up intermediate signal boxes, and thus shortening the sections instead of having this special working, is the safer though more expensive plan.

And now we come to the use of the advanced starting signal. This signal is by no means universal, but its use came about in the following manner. It was necessary to have some fixed signal in advance of the point where any station siding debouched on the main line, in order to prevent any train starting away without a proper fixed signal, and to give the signalman in his cabin (tower) the power to be certain about this. Moreover, on lines where the traffic was thick (principally south of the Thames), it was found necessary to pass trains along with great rapidity, and so it was suggested that—to take our diagram—it would be safe enough to allow the signalman at B, when he could not allow a train to leave his station because C had not given his "line clear" or accepted his "be ready," to let the train advance to a signal placed in front of the starting signal, and then to give "line clear" back to A and to accept A's "be ready," as there would be a considerable interval between the tail of the train standing at the advance starting signal (4*b*) and the home signal (2*b*). It will be observed that this practically makes the signalman control two trains at once, and in the writer's



EASEMENT CURVES. MO. PAC. RWY. CHANGING 1° EACH 50 FT. FROM TANGENT TO MAIN CURVE

DISTANCE FROM I.P. TO P.C. OR P.T. = T = T' + t = (R' × TAN. ½I) + t



TOTAL CURVATURE IN MAIN CURVE = I − (2 × TOTAL CURVATURE IN ONE EASEMENT)

TOTAL LENGTH OF CURVE = LENGTH OF MAIN CURVE + 2 × (LENGTH OF ONE EASEMENT)

T = DISTANCE TOWARD THE CENTER FROM A PLAIN CURVE OF GIVEN DEGREE TO MAIN CURVE OF SAME DEGREE WITH EASEMENTS

DEFLECTIONS BELOW AND LEFT OF DIAGONAL ARE BACK DEFLECTIONS. I.E.: DEFLECTIONS TO POINTS ON THE EASEMENT FROM THE TANGENT WHEN THE INSTRUMENT IS AT THE B.C. OR E.C.

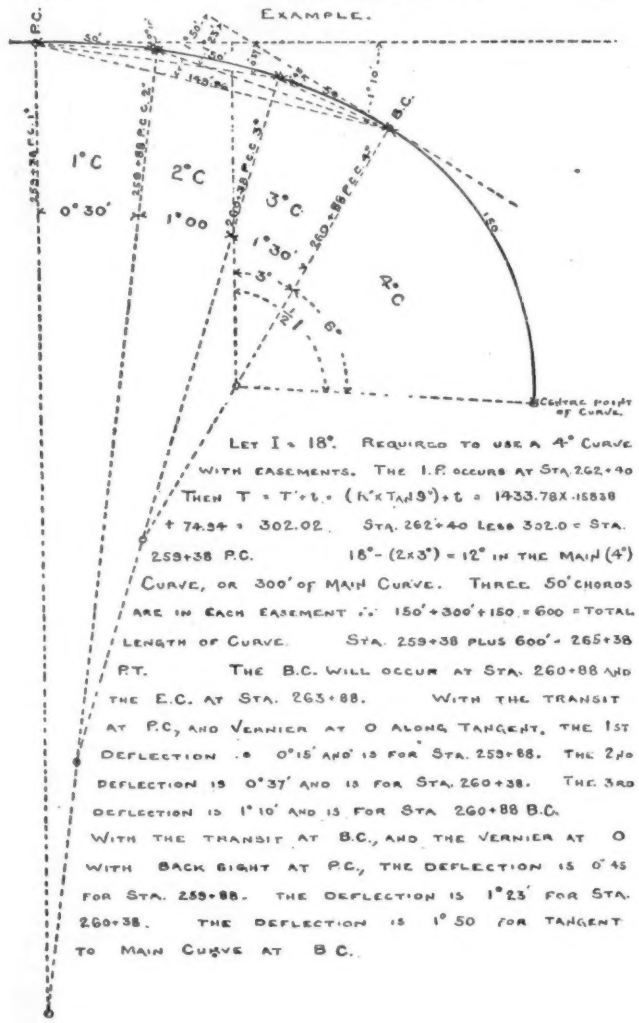
DEGREE OF MAIN CURVE	R'	t	TOTAL CURVATURE IN ONE EASEMENT CURVE	T	LENGTH OF LONG CHORD FROM B.C. OR E.C. TO P.T.
2°	2865.04	24.98	0° 30'	0.11	50.00
3°	1910.52	49.95	1° 30'	0.44	100.00
4°	1433.78	74.94	3° 00'	1.09	149.96
5°	1148.45	99.91	5° 00'	2.17	199.90
6°	959.18	124.82	7° 30'	3.81	249.80
7°	825.10	148.64	10° 30'	6.08	299.55
8°	725.90	174.36	14° 00'	9.12	348.08
9°	650.26	208.30	18° 00'	12.99	396.07
10°	591.50	223.18	22° 30'	17.81	443.16

DEFLECTIONS

INST. AT	P.C. 0	c.c. 2° +50	c.c. 3° 1	c.c. 4° +50	c.c. 5° 2	c.c. 6° +50	c.c. 7° 3	c.c. 8° +50	c.c. 9° 4	c.c. 10° +50
P.C. 0	.....	0° 15'	0° 37'	1° 10'	1° 52'	2° 45'	3° 48'	5° 00'	6° 22'	7° 54'
c.c. 2° +50	0° 15'	.....	0° 30'	1° 07'	1° 55'	2° 52'	4° 00'	5° 18'	6° 45'	8° 22'
c.c. 3° 1	0° 53'	0° 30'	.....	0° 45'	1° 37'	2° 40'	3° 52'	5° 15'	6° 48'	8° 30'
c.c. 4° +50	1° 50'	1° 23'	0° 45'	.....	1° 06'	2° 07'	3° 25'	4° 52'	6° 30'	8° 18'
c.c. 5° 2	3° 08'	2° 35'	1° 53'	1° 00'	.....	1° 15'	2° 37'	4° 10'	5° 52'	7° 45'
c.c. 6° +50	4° 45'	4° 08'	3° 26'	2° 23'	1° 15'	.....	1° 30'	3° 07'	4° 55'	6° 52'
c.c. 7° 3	6° 42'	6° 00'	5° 08'	4° 05'	2° 53'	1° 30'	.....	1° 45'	3° 37'	5° 40'
c.c. 8° +50	9° 00'	8° 12'	7° 15'	6° 08'	4° 56'	3° 23'	1° 45'	.....	2° 00'	4° 07'
c.c. 9° 4	11° 38'	10° 45'	9° 42'	8° 30'	7° 08'	5° 35'	3° 53'	2° 00'	.....	2° 15'
c.c. 10° +50	14° 36'	13° 38'	12° 30'	11° 12'	9° 45'	8° 08'	6° 20'	4° 23'	2° 15'	.....

EASEMENT CURVES. MO. PAC. RWY. CHANGING 1° EACH 50 FT.

EXAMPLE.



LET I = 18°. REQUIRED TO USE A 4° CURVE WITH EASEMENTS. THE I.P. OCCURS AT STA. 262+40 THEN T = T' + t = (R' × TAN 9°) + t = 1433.78 × .15838 + 74.94 = 302.02. STA. 262+40 LESS 302.0 = STA. 259+38 P.C. 18° − (2×3°) = 12° IN THE MAIN (4°) CURVE, OR 300' OF MAIN CURVE. THREE 50' CHORDS ARE IN EACH EASEMENT ∴ 150' + 300' + 150' = 600' = TOTAL LENGTH OF CURVE. STA. 259+38 PLUS 600' = 265+38 P.T. THE B.C. WILL OCCUR AT STA. 260+88 AND THE E.C. AT STA. 263+88. WITH THE TRANSIT AT P.C., AND VERNIER AT 0 ALONG TANGENT, THE 1ST DEFLECTION IS 0° 15' AND IS FOR STA. 259+88. THE 2ND DEFLECTION IS 0° 37' AND IS FOR STA. 260+38. THE 3RD DEFLECTION IS 1° 10' AND IS FOR STA. 260+88 B.C. WITH THE TRANSIT AT B.C., AND THE VERNIER AT 0 WITH BACK SIGHT AT P.C., THE DEFLECTION IS 0° 45 FOR STA. 259+88. THE DEFLECTION IS 1° 23' FOR STA. 260+38. THE DEFLECTION IS 1° 50 FOR TANGENT TO MAIN CURVE AT B.C.

Easement Curve Tables and Example of their Application. By Willard Beahan.

opinion it is an objectionable signal, as it really forms each block section, which ought to be one and indivisible, into two sections controlled by one signal-box. It is perfectly safe at junctions, where it allows a train to pull off a main line on to a branch, in order to clear the main line, provided, of course, that the signal-box is placed in a good position for seeing that the tail vehicle of the train so pulled is well clear of the main line.

I do not think that the fact stated in your note, viz., that the starting signal has to be passed before "line clear" is given back, is at all generally observed in England. Some lines, however, I regret to say, show a growing tendency to work up to signals without any warning arrangement, with passenger trains, owing to the general adoption of continuous brakes. This is certainly not keeping to the spirit of the "block system," which consists essentially in keeping an interval of *space* instead of *time* between trains.

The importance of the subject must be my excuse for the length of this letter. T. C. FARRER.

F. W. Dean's Supplementary Paper on the Strong Locomotive.

CAMBRIDGEPORT, Mass., May 27, 1889.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Your remarks on my supplementary paper on the Strong locomotive, in your last issue, show a complete misconception of the purpose of the paper. In the first place, you treat it as if it were one by itself, instead of an additional leaf to another paper. It ought not to be read except in conjunction with the original. The supplement sought to give evidence of the correctness of a suspicion that No. 444's (L. V. R. R.) steel valves leaked. It succeeded in giving that evidence. I did not care to obtain "show" cards from the Strong engine because the object was to compare them with certain other "every-day" cards which are shown in my original paper.

You appear to object to my computing the amount of steam used from the indicator diagrams. Nevertheless that is the true way to examine and compare the action of valve gears. Nobody supposes that this gives the actual amount of water used, as that is some 30 per cent. more. The difference is due to condensation of the steam on its way to the cylinders, in the cylinders and to priming. The performance of the pure function of the valve gear can be best seen from the cards.

Furthermore, you state that the back pressures shown on the cards in the supplementary paper are greater than those given by other gears, and you think it a pity that I should so misrepresent the Strong engine. I very much doubt your ability to substantiate your statement. You, in common with all of my critics, ignore the fact that the engine burns inferior anthracite coal and is draughted to steam up a 96 ft. grade 12 miles long. The anthracite locomotives which you illustrated in your issue of January 6, 1888, having 19 in. by 24 in. cylinders and 40 sq. ft. of grate area, running upon the Erie, work with a pair of 3 in. nozzles. The Strong engine No. 1, recently in competition with these engines, used two 3½ in. nozzles. The 19 in. by 24 in. Lackawanna engines running out of Scranton use two 3⅛ in. nozzles. What, then, but great back pressure can be expected? Anthracite coal on locomotives now-a-days is so poor that this state of affairs must exist, and as far as back pressure is concerned, anthracite engine cards cannot with justice be compared with those from a bituminous engine.

Again, I should be surprised to see a set of authentic cards from an anthracite, link-motion, stay-bolt boiler engine developing continuously 800 to 1,000 horse power at 180 to 250 revolutions per minute with less back pressure than shown by the cards under notice. You will find, that instead of being less, it will be nearly twice as much. F. W. DEAN.

Easement Curves.

SANTIAGO, Chili, S. A., March 30, 1889.

TO THE EDITOR OF THE RAILROAD GAZETTE:

The copy of the *Railroad Gazette* of Feb. 8 has reached me here. The article on "Transition Curves," E. A. Gieseler, was read with interest. As my number of the *Gazette* containing the first part of his paper went to another address I cannot closely follow his discussion. Having had a little experience in the computation, arrangement and field application of these curves, I wish to ask if it is not better to compute them without using the calculus? Each railroad system using such transition or easement curves (the latter term seems to me the better one) will desire a table differing from other roads having different alignment. Again, shall we not need for the same company different tables for maintenance of way than for location work? Usually in the former case the tangents need shifting, in the latter case the tangents remain the same, usually, while the curve is thrown in towards its centre. The method of computation should therefore be such as to be as readily understood and as easily applied as possible. For this reason a trigonometric solution that is not long or complicated would be preferable. Let us do pioneer work simply. It encourages followers. Mr. Searle's excellent little treatise on the "Railroad Spiral" is the only printed literature, to my knowledge, in common circulation on the subject. It is fully time the theory and method of using these curves be familiar to others than college professors and students of the more untried problems. Use the calculus when it serves the purpose *better*, never use it before. To so write requires some fortitude.

Unless Mr. Gieseler's article is entirely misunderstood by me his method is an offset method. We cannot take time for any offset method of curve running unless entirely unavoidable. These comments are not to be considered as unfriendly ones. He is writing tersely upon a topic on which light is badly needed. I prize the paper, and ask can he not get a more useful result by a plainer path?

With the hope of giving what aid I can, I inclose a copy of an easement curve table computed last year by me for the Missouri Pacific Railway, whose employé I then was. The computation was made in a locating camp in spare hours by the engineers of that field party, Messrs. J. G. Jennings, J. E. Read, A. S. Nye, Jr., and myself. We then used it in locating for several months. The computation was trigonometric. It was not tedious or heavy. It was a little knotty at times. Through the kindness of William Hood, Chief Engineer Southern Pacific Railway, I had some months previously received a copy of the "tapering curves" used by him. This inclosed table is directly due to his aid to me, and I claim no credit whatever save the arrangement of table. I had to re-compute his table for the Missouri Pacific, for we used 50 ft. stations on curves, and as our curves seldom exceeded a 6 degree we wanted a longer easement. The arrangement of this inclosed table I think better, and the nomenclature better. It is more compact and very readily understood. It was and is my wish to do something to aid in bringing into general use these easement curves. To me they seem a valuable betterment. My experience leads me to think they add about 1 per cent. to the cost of location work. Mine is purely a deflection method. All the angles are shown necessary to set up on any point on any easement, backsight to any other point on that easement and put in any third point. The example given is merely explanatory.

To any railroad company wishing to use this form of table I will gladly give the right to do so. It is copyrighted, so as to be mine to give away, and not mine to buy from an enterprising printer. To Mr. Butts, for insertion in his field book for location engineers, it is available at any time. It was my purpose to write, before this, a paper for the St. Louis Engineers' Club, explaining and giving in full my way of computing these curves. My present duties too fully occupy my time to permit this.

When railroad engineers more clearly understand easement curves, we shall be better prepared to discuss them. I think we shall then use them more. Of this we can better judge later. Says one gentleman, whose opinion we all prize: "They are an excellent thing; would put them in on maintenance were it not for the expense. I dislike tables. Can you not formulate or even memorize them?" Says another: "I am not an advocate of easement

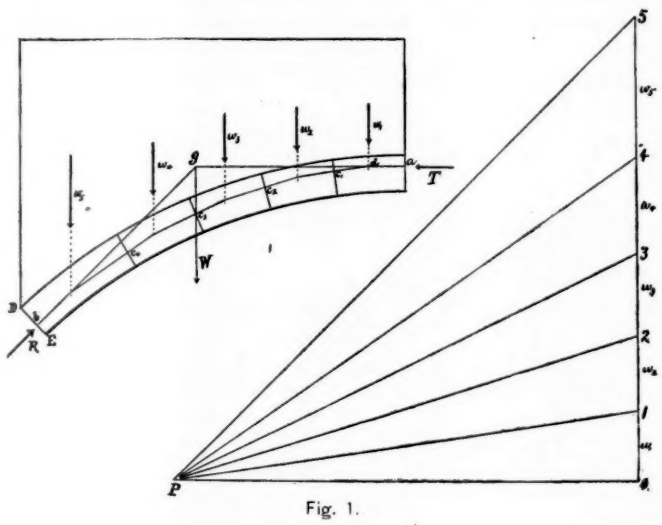


Fig. 1.

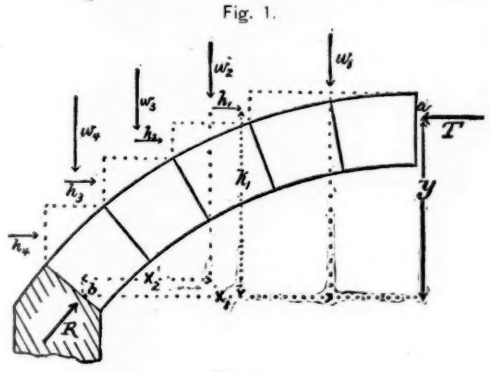


Fig. 2.

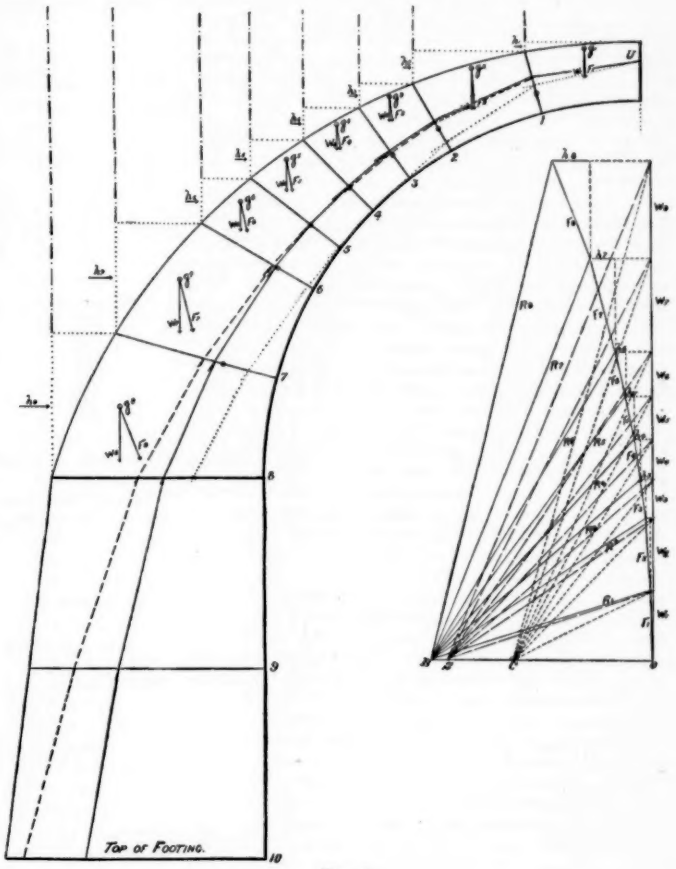


Fig. 3.

THE THEORY OF THE MASONRY ARCH.

curves under any circumstances." Says a third: "They are all right. I have used them, but could not make track men keep them." Says a fourth: "Yes, our oldest division was located by a compass set up often, and we sharpened or flattened at each set-up. It rides easier at ends of curves *now* than the divisions located since with a transit. The middle of the curve is thrown in and the track has a flatter curve always, from necessity. I wish we could taper curves with a transit as we used to do with a compass." I have now given you the judgment of the Chief Engineers of four of the leading railroads of the United States as expressed to me on this subject. Some one is wrong. The jewel of consistency does not shine from the paragraphs wherein these judgments are grouped.

Cannot some common ground of comprehension of this matter be reached? Are we locating lines for high speeds, especially if the curves be sharp and the tangents be short, as well as our predecessors did a number of decades ago? Much can now be done on maintenance of old track to remedy this bad tendency, accidentally due to a transit field method. But the time to properly align a road is prior to grading. Our locating is slighted, and we all shirk. Should not the west learn from the east, through the latter's paid-for experience?

WILLARD BEAHAN.

An Error in A Common Theory of the Masonry Arch.

BY IRA O. BAKER, PROFESSOR OF CIVIL ENGINEERING, UNIVERSITY OF ILLINOIS.

Numerous theories of the masonry arch have been proposed from time to time, which vary greatly in the fundamental principle involved. Unfortunately, the underlying assumptions are not usually stated, and, as a rule, the theory is presented in such a way as to lead the reader to believe that each particular method "is free from any indeterminateness, and gives results easily and accurately." The writer is of the opinion that no theory can claim to be any more than an approximation. In the present state of our knowledge every theory of the masonry arch is approximate, owing to the uncertainty concerning the amount and distribution of the external forces, to the indeterminateness of the position of the true line of resistance, to the neglect of the influence of the adhesion of the mortar and of the elasticity of the material, and to the lack of knowledge concerning the strength of masonry; and, further, the strains are indeterminate owing to the effect of variations in the material of which the arch is composed, to the effect of imperfect workmanship in dressing and bedding the stones, to the action of the centre—its rigidity, the method and rapidity of striking it—to the spreading of the abutments and to the settling of the foundations.

There are not a few who, recognizing the imperfections and limitations of all the theories, refuse to be guided by them and rely wholly upon empirical rules derived from existing structures: but there is no branch of engineering practice that can be made to conform to strict mathematical analysis; and the above indictment of the theory of the masonry arch would seem much less severe if it were compared with that which might be brought against almost any branch of engineering practice—as, for example, the analysis of the strains in a bridge truss. The theory of the masonry arch, if its limitations are steadily borne in mind, and if its principles are properly applied, may be of great value in studying existing structures with a view of deriving rules for further practice. It is only by modifying theory as indicated by practice, and changing practice to accord with improved theory, that we can ever arrive at anything like perfect practice.

The writer has no intention to enter here upon a discussion of the several theories, or of even one of them, but desires only (1) to point out what he believes to be a serious and common error in the application of theory, and (2) to explain a precaution to be taken in using existing structures for guides in future construction.

In finding the strains in a masonary arch it is frequently assumed that the semi-arch, as in fig. 1, for example, is held in equilibrium by the three forces T, W, and R; T being the resultant reaction of the right-hand half of the arch upon the left-hand half, W the resultant of the external forces acting on the arch, and R the reaction of the springing joint. For reasons not necessary to state here, it is usually assumed that T is horizontal and applied at the upper extremity of the middle third of the crown joint, and that R is applied at the inner end of the middle third of the springing joint. The external forces are assumed to be vertical.

The position of the centre of gravity of the load on the semi-arch (including its own weight) is computed, and the position of W is laid down on the drawing of the arch. In fig. 1, T and W intersect in g, which, from well known principles, must also be a point in the line of action of R; and, therefore, a line from g to b determines the direction of R. To find the amount of T and R, lay off W, in the force diagram, vertically from 0 to 5, and draw a line, $P0$, through 0 parallel to T, and also one through 5 parallel to $g\,b$; then $P0 = T$, and $P5 = R$.

Complete the force diagram by dividing the line 0 5 to correspond to the load on the several voussoirs, and connecting each point of division with P. To draw the line of resistance, from the point d, in the diagram of the arch, where T and w_1 intersect, draw a line $d\,c_1$, parallel to $P1$ of the force diagram, and c_1, where this line intersects the first joint, is the centre of pressure on that joint; and from the point of intersection of $d\,c_1$ and w_2 draw a line parallel to $P2$, and c_2, the point where this line pierces the second joint, is the centre of pressure on that joint. The centres of pressure for the other joints are found in a similar manner. A line connecting c_1, c_2, c_3, etc., the centres of pressure of the several joints, is the line of resistance, but is not shown in fig. 1.

As evidence that the above method of analysis is unreasonable, it is only necessary, at the present, to say that many structures which stand without any evidence of failure, when analyzed by this method appear to be incapable of standing for a moment. Experience then gives evidence sufficient to prove that the above method of analysis is seriously in error.

Where is the error? Principally in finding the value of the thrust at the crown. If b, instead of being taken in the joint $D\,E$, were assumed to be in the next joint lower, the thrust would be smaller than as above, and the resulting line of resistance would run nearly straight from a to b. But, on the other hand, if the origin of moments, b, is in a joint higher than as shown in fig. 1, the crown thrust will be greater, and the corresponding centres of pressure will lie closer to the middle of the several joints. Evidently the apparent stability or instability of the arch depends upon the assumed position of b. Was the proper position chosen in the above method of solution? Probably not, since no analysis is reasonable which makes an arch appear to be unstable that shows no evidence of weakness.

Is there a better method? Let us see. To make an analysis of the strains in a masonry arch, it is necessary to know (1) the amount, (2) the direction, and (3) the point of application of the resultant crown thrust. It is almost universally assumed, as above, that this thrust is horizontal, and applied at the upper extremity of the middle third of the crown joint; but to find its amount various hypotheses have been proposed. Probably nineteen-twentieths of those who intelligently use any theory of the arch employ Moseley's hypothesis of minimum crown thrust. This assumes that the thrust at the crown is a passive force called into action by the external forces; and that, since there is no need for a further increase after it has caused stability, it will be the least possible consistent with equilibrium. If the thrust at the crown were less than the value that causes stability, some joint would open at the back; and a greater thrust is inconsistent with the hypothesis. Hence it is necessary to find the minimum thrust which, applied at the crown, will prevent any joint of a semi-arch opening at the back.

The half arch shown in fig. 2 is held in equilibrium by (1) the vertical forces w_1, w_2, etc., (2) by the horizontal forces h_1, h_2, etc., (3) by the reaction R at the abutment, and (4) by the thrust T at the crown. The direction of R is immaterial in this discussion. Let a and b represents the points of application of T and R, respectively, although the location of these points is yet undetermined. Let

T = the thrust at the crown;

x_1 = the horizontal distance from b to the line of action of w_1, x_2 = the same for w_2, etc.;

y = the vertical distance from b to the line of action of T;

k_1 = the vertical distance from b to the line of action of h_1, k_2 = the same for h_2, etc.;

Then, by taking moments about b, we have

$$Ty = w_1 x_1 + w_2 x_2 + \text{etc.}, + h_1 k_1 + h_2 k_2 + \text{etc.} \quad (1)$$

Hence

$$T = \frac{\Sigma\, w\, x}{y} + \frac{\Sigma\, h\, k}{y} \quad (2)$$

The joint of rupture is that joint for which the tendency to open at the extrados is the greatest. The joint of rupture of an arch is analogus to the dangerous section of a beam. That no joint may open at the extrados, the thrust at the crown must be at least equal to the maximum value of T as determined by equation (2). If the thrust is less than this, the joint of rupture will open; and a greater value is inconsistent with the hypothesis of minimum crown thrust.

To illustrate the method of applying these general principles, let us determine the joint of rupture and also the line of resistance of the 16-ft. semi-circular arch shown in fig. 3, when supporting a bank of earth 10 ft. deep at the crown. This arch is the standard form employed on a prominent Western railroad.

The value and position of the components of the external forces are somewhat indeterminate. According to Ran-

k ine's theory of earth pressure, the horizontal pressure of earth at any point cannot be *greater* than $\frac{1+\sin\varphi}{1-\sin\varphi}$ times the vertical pressure at the same joint, nor *less* than $\frac{1-\sin\varphi}{1+\sin\varphi}$ times the vertical pressure, — φ being the angle of repose.*

If = 30 deg., the above expression is equivalent to saying that the horizontal pressure cannot be greater than *three* times the vertical pressure nor less than *one third* of it. Evidently the horizontal component will be greater the harder the earth spandrel-filling is rammed into place. The condition in which the earth will be deposited behind the arch can not be foretold, but it is probable that at least the minimum value as above will always be realized. Hence we will assume that the horizontal component is at least *one third* of the vertical pressure; that is to say, $h = \frac{1}{6}\ w\ d\ l$, in which w is the weight of a cubic unit of earth—which may be assumed at 100 lbs.—d the depth of the centre of pressed surface below the top of the earth filling and l the vertical dimension of the surface. The value and the position of the horizontal force acting on the respective sections of the arch ring are given in the second double column of the table.

Assume, as above, that the origin of moments (the centre of pressure) for any joint is at a distance from the intrados equal to one-third of the length of the joint. The co-ordinates to the several centres of pressure are given in the third double column of the table. The length of the crown joint is 1.25 ft. The thrust at the crown is assumed, as above, to be applied at the upper limit of the middle third of the crown joint. Notice that the several values of x, k, and y are simply the differences between two quantities given in the table. The last three columns of said table contain the partial values and also the total value of the crown thrust as computed by equation (2) above.

An inspection of the results in the last column of the table shows that the thrust is a maximum for joint 4. A repetition of the computations, using smaller divisions of the arch ring might show that the absolute maximum occurs a little to one side or the other of this joint; but the uncertainty in the data for both the vertical and the horizontal forces is too great to justify an attempt at absolute accuracy, and hence we will assume that joint 4 is the true joint of rupture. The angular distance of this joint from the crown is 45 deg., which quantity is termed the *angle of rupture*.

Any increase in the assumed intensity of the horizontal components increases the computed value of the angle of rupture. For example, if the quantities in the next to the last column of the table be doubled, the thrust for joint 7 will be the maximum. Probably this condition could be realized by tightly tamping the earth spandrel-filling.

To construct the force diagram, a line $B\ 0$ is drawn to scale to represent the maximum thrust, as found in the fourth line of the last column of the table. From 0 w_1 is laid off vertically upwards, and from its extremity h_1 is laid off horizontally to the left; then the line from 0 to the left-hand extremity of h_1 (not shown in this particular case) represents the direction and amount of the external force F_1 acting upon the first division of the arch stone, and the line R_1 from B to the upper extremity of F_1 represents the resultant pressure of the first arch stone upon the one next below it. Similarly lay off w_2 vertically upwards from the left-hand extremity of h_1 and then lay off h_2 horizontally to the left. A line F_2, from the the upper end of w_2 to the left-hand end of h_2, represents the resultant of the external forces acting on the second divisions of the arch, and a line R_2, from the upper extremity of F_2 represents the resultant pressure of the second arch stone on the third. The force diagram is completed by drawing lines to represent the other values of w_1, h_1, F_1 and the corresponding reactions.

In the diagram of the arch, the points in which the horizontal and vertical forces acting upon the several arch stones intersect are marked g_1, g_2, etc., respectively, and the oblique line through each of these points shows the direction of the resultant external force acting on each arch stone. The line of resistance shown by the solid line is drawn by exactly the same process as that explained in fig. 1 above.

The line of resistance shown in fig. 3 by the dash line was determined on the assumption that the external forces were vertical; that is to say, the crown thrust was assumed to be 8,748 lbs., as given in the third line of the third from the last column of the table. The line of resistance represented in fig. 3 by a dotted line was determined on the assumption (1) that the crown thrust was 5,990 lbs. as in the last line of the third from the last column of the table and (2) that the external forces were wholly vertical; that is to say, the dotted line represents the line of resistance according to the erroneous method objected to above.

Concerning the reliability of the method of analysis which gives the dotted line for the line of resistance, notice that if this were the true line of resistance the arch could not stand for a moment, whereas it not only does stand, but carries without any signs of weakness a heavy railroad traffic in addition to the load used in the above computations; and further, any reasonable analysis shows that it is extravagantly strong. It is clear then that this method of analysis is seriously in error.

The line of resistance shown by the dash line is that obtained by the common theory of the arch when correctly applied. This theory is defective in that it omits the horizontal component of the external forces. This horizontal pressure is regarded of the utmost importance in proportioning retaining walls; and yet, astonishing as it may seem, the effect of the horizontal component of the earth pressure is entirely neglected in the ordinary theory of the arch. The

*Rankine's Civil Engineering, p. 320.

TO FIND THE JOINT OF RUPTURE OF THE ARCH RING SHOWN IN FIG. 3.

No. of the joint, counting from the one next to the crown.	Data for vertical forces.		Data for horizontal forces.		Position of the centre of pressure for each joint.		Thrust at the crown.		
	Amount.	Horizontal distance of point of application from the crown joint.	Amount.	Vertical distance of point of application from the top of the crown joint.	Horizontal distance from the crown joint.	Vertical distance from the top of the crown joint.	$\frac{\Sigma w x}{y}$	$\frac{\Sigma h R}{y}$	Total thrust.
	Pounds.	Feet	Pounds.	Feet	Feet	Feet	Pounds.	Pounds.	Pounds.
1.....	2,938	1.20	66	0.10	2.20	1.18	3,866	94	3,960
2.....	3,045	3.57	243	0.55	4.27	1.86	7,744	308	8,052
3.....	1,644	5.33	192	1.17	5.27	2.42	8,518	424	8,942
4.....	1,716	6.45	259	1.78	6.17	3.11	8,748	662	9,400
5.....	1,825	7.50	315	2.53	6.98	3.90	8,577	700	9,277
6.....	1,888	8.47	415	3.40	7.71	4.81	8,407	941	9,348
7.....	3,939	9.77	1,030	5 02	8.85	6.84	7,506	1,407	8,911
8.....	4,098	11.05	1,624	7.70	9.50	9.25	5,990	1,983	7,973

omission of the horizontal components frequently adds to the stability of the arch, but this is not necessarily so. It is certainly not scientific to neglect an element of considerable importance, and then apply mathematical analysis to determine a result which depends upon partial data. The difference between the line of resistance represented by the dash line, and that shown by the solid line, is not material above the joint of rupture; but below that joint the difference is marked, and greatly affects the computed stability of the abutment. An inspection of fig. 3 makes this apparent.

A study of existing arches leads one to believe that the above erroneous method has caused many structures to be built extravagantly heavy. For example, an analysis of the strains in a standard-form arch culvert (span = 16 ft.) of another prominent railroad shows that the *nominal* maximum pressure was 54 lbs. per square inch, which is only about one eighth or one tenth of the *actual* load on bridge piers, while the actual pressure on the arch is considerably less, possibly only half that mentioned above; or, in other words, the arch was built of the *first-class* masonry, composed of the very best limestone, whose crushing strength in cubes is probably about 20,000 lbs. per square inch, or the strength of slabs is probably about 40,000 lbs. per square inch, and the strength of the masonry is probably more that one sixth or one seventh as much, or about 6,000 lbs. per square inch; and, therefore, the *nominal* factor of safety is 6,000 ÷ 54 = say 100, and the actual factor is still greater.

Of course there are other features of the problem to be taken into account, but they will not materially alter the above conclusions, which the writer believes are substantiated by many existing arches. The writer does not wish to be understood as advocating the lightest arch that can possibly be made to do, but he desires to call attention to the fact that one of the theories in somewhat common use is neither logical nor substantiated by experience.

Mogul Locomotive, Canadian Pacific.

The Mogul locomotive illustrated in this issue, was designed by Mr. Francis R. F. Brown, Mechanical Superintendent of the Canadian Pacific, as a standard for that line. Forty of these locomotives have been built and are in operation on various sections between the Atlantic and Pacific oceans, and the reports regarding them are very satisfactory both in economy of fuel and durability of parts. The locomotives are free steamers, and have short, rigid wheels bases. The following is a list of the principal dimensions:

CYLINDERS AND MOTION.	
Diameter and stroke	18 in. × 24 in.
Distance apart of centres	6 ft. 11 in.
Steam ports—length and width	17 in. × 1½ in.
Exhaust ports—length and width	17 in. × 3 in.
Diameter of piston rod	3¼ in.
Length of connecting rod	7 ft. 8 in.
Journal of connecting rod—length and diameter	5 in. × 4½ in.
Travel of valve	5½ in.
Throw of eccentrics	5½ in.
Lap of valve	⅞ in.
Lead	3-16 in.
WHEELS AND FRAME.	
Driving wheels, diameter	4 ft. 9 in.
Driving wheel tires, thickness	3 in.
Driving wheel tires, leading and trailing, flanged width	5½ in.
Driving wheel tires, main driving, plain	6 in.
Driving axle journals, diameter and length	7 in. × 8 in.
Truck wheels, diameter	30 in.
Truck wheels, tires, width and thickness	5 in. × 2½ in.
Truck axle journals, diameter and length	5 in. × 8 in.
Fixed wheel base	14 ft. 6 in.
Total wheel base of engine	21 ft. 11½ in.
Thickness of frames	3¼ in.
Width over frames	4 ft. 2¼ in.
Width between tires	4 ft. 5½ in.
C of cylinder to C of driving axle	11 ft. 10⅞ in.
BOILER.	
Length of barrel	11 ft. 5¼ in.
Diam. of smallest course outside	4 ft. 6 in.
Thickness of plate	½ in.
Fire box shell, sides, thickness	½ in.
" " throat, back and top, thickness	9-16 in.
" " inside, crown and back	⅜ in.
" " sides	5-16 in.
Tube plates, thickness	½ in.
Fire box, inside length	8 ft. ½ in.
" inside width, bottom and top	3 ft. 6 5⁄8 in. and 3 ft. 9 in.
" outside length	8 ft. 9 in.
" outside width, bottom	4 ft. 2 in.
" total depth inside, front and back	4 ft. 9 in. and 3 ft. 6¾ in.
Number of tubes	208
External diameter	2 in.
Length between tube plates	11 ft. 8 1⅛ in.
Heating surface—tubes	1277 3 sq. ft.
Heating surface—fire box	110.7 sq. ft.
Heating surface—total	1388.0
Grate area	28.7 sq. ft.
Weight in working order—on truck	13,000 lbs.
Weight in working order—on drivers	87,000 lbs.
Weight in working order—total	100,000 lbs.
Weight of tender—empty	30,000 lbs.
Capacity of tender—coal	10 tons.
Capacity of tender	3,360 gals.

Tender fitted with 33 in. C. I. wheels of special weight and quality.

The "Gresham" combination injector, with which these locomotives are fitted, is mounted on the boiler back head, and is so constructed as not to require the use of either injector check or starting valve. There are no pipes outside of the boiler to be ruptured in collisions, and no check or starting valves to maintain. This class of injector is worthy of attention, as it removes one of the unsightly objects on the side of a locomotive boiler and enables the wipers to clean the boiler jacket in a satisfactory manner.

The steam ports in the cylinders of these locomotives are large for the size of cylinder; an advantage rather than otherwise. The boilers are built to carry a pressure of 180 lbs. to the square inch. Therefore, the mean effective pressure in the cylinders, when the valve motion is in full gear, is considerably greater than in most locomotive engines of this type. The distribution of the weight is admirable, over 13,000 lbs. being placed upon the front truck and 87 per cent. of the total weight upon the drivers. The truck is a radius bar truck, and the engine passes around the sharpest curves with steadiness and freedom.

The frames are forged solid from the back end to a point just forward of the leading drivers, and the upper and lower bars of the front frame, which embrace the cylinders, are connected to the main frame by spliced and keyed joints. Both frame bars are extended to the back of the buffer beam, being there keyed and bolted together, and to smoke box stay, the upper bar being recessed on top for a heavy cross plate which is laid on flat. All the parts at this point are rigidly secured to the buffer beam by angle irons, thus forming an efficient protection for the cylinders in case of collision.

The back ends of the frames are securely bolted to a heavy cast iron foot plate. The middle portions are stayed entirely independent of the boiler with the exception of one stay back of the main driver, which is fastened to the bottom of the front end of the foundation ring as well as bolted to the frames. This stay is flexible enough to allow the boiler to expand and still prevent twisting of frames.

The fire-box is spread over the frames and is supported by cast steel slippers on top of the frames and by side and back links, secured to pins in the frame, and forged brackets on the fire-box. The fire-box is re-inforced by ½-in. plates where these brackets are fastened. The grate is rocked in two sections by separate handles on the face-plate, and the dump bar can be easily worked by one hand from the foot plate. The ash pan is constructed in sections so as to be easily removed without taking down any other part but the dump grate shaft, thus enabling any repairs to be made without taking the wheels out. Both ash pan and grate carriers are rigidly connected to the foundation rings only, and not to the fire-box sheets or frame in any way. The boiler plates are all Siemens-Martin mild steel of fire-box quality, imported from Scotland, with the exception of the connection ring from barrel to smoke-box, which is of Low Moor iron welded, and the whole are sheared, punched and riveted by Tweddell's hydraulic machinery, with steel rivets and stays of extra quality iron.

The steam valves are balanced by thin strips. The U. S. metallic packing is used for piston rods and valve stems. The crossheads are of mild cast steel, of the Laird type, and have hard brass blocks, with side bearings babbitted and run between forged steel slide bars. The driving axle boxes are of cast steel and have brass liners to prevent cutting the driving wheel hubs. The rocker arms and radius links also are of cast steel.

The truck wheels are of cast iron, of special weight and quality.

The locomotives are equipped with driver brakes on all driving wheels, a separate reservoir being used to supply air for this purpose.

Feed-water is supplied by two No. 9 Gresham & Craven combination injectors. Sight feed lubricators are used to supply oil for the lubrication of the cylinders. The cylinders, steam chest, and all steam passages are carefully covered to avoid as nearly as possible all condensation.

The sand box casing is made of cast iron with a No. 10 steel centre. The cover is recessed into the top of the casing and the handle also in order to leave the outline of the sand box perfectly smooth. The construction is clearly shown in the illustration. The method of holding the lagging at the sand box is worthy of mention. The sand box base has a projection on it which runs out under the wooden lagging, and holds it in proper position. This arrangement must materially decrease the labor of applying the lagging, because there is no necessity of blocking up in order to make the covering match the head on the

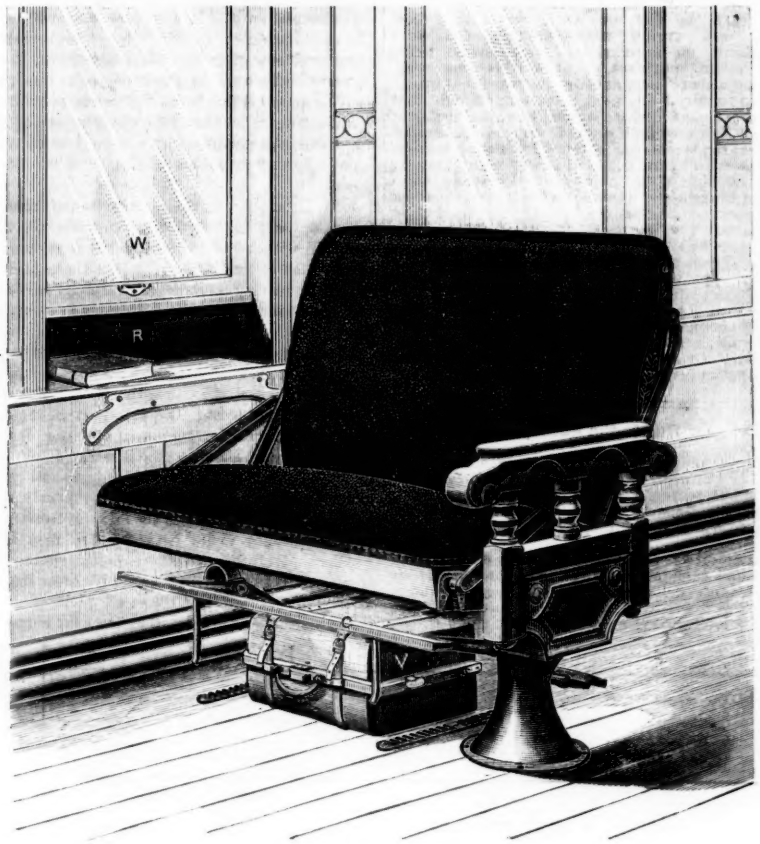


Fig. 1.

THE IMPROVED FORNEY CAR SEAT.

sand box base. When the lagging is old the jacket will stay in position, which is not the case when it is supported by a wooden strip placed directly on the boiler and subjected to the charring effect of the high-pressure steam. The sand-box being heavy when filled with sand, it is necessary that it should be supported directly by the boiler, and unless the lagging at this point is supported by a positive metal ring it will soon fall away and fail to match the thin edge of the sand-box base.

The dome casing is made of hammered mild steel, No. 14 wire gauge in thickness. This thin and light metal casing is supported directly by the lagging.

Heavy cast iron knees are used to support and retain the cab in position. They are shown in the illustration.

The fire-box is fitted with a brick arch placed close up to the tubes and crown sheet. Between the back and main drivers, a connection is forged between the upper and lower bars of the frame where the supporting links are attached. This is a new and commendable departure.

Boiler makers will be interested to notice the method of attaching the cross stay just in front of the fire-box over the crown-sheet. The presence of a seam in the outer shell at this point interferes with the application of the usual form of stay. In this case the difficulty has been overcome by the use of a stay with a fork end, which passes between two angle irons, one placed in front, the other in the rear of the outer shell seam at that point. This is clearly shown in the illustration. The method of attaching the crown stays to the crown bars by making them forked is new. It is somewhat expensive, but has the advantage of making the strains upon the crown-sheet more uniform because the pull of the stay is carried to each crown bar instead of to every other one as usual.

The dry pipe in this locomotive is very large. It is 7⅝ in. in diam., of wrought iron. The endeavor seems to have been to furnish a full and well-sustained steam supply to the cylinders.

Inclining the crown sheet of the fire-box backward, results in decreasing the fire-box heating surface and complicates the staying of the back head when the ordinary form of staying is used. However, in this design the use of the gussets stays obviates any difficulty from this cause. The principal advantage of the backward slope is that it gives more water on top of the fire-box for grade work, and prevents the water rising. The staying of the crown of the fire-box is of two kinds—radial screw stays and crown bars, the crown bars being used under the dome where screw stays are impossible. The reader will notice that the injectors are supplied with steam directly from a pipe in the dome, and that they deliver the feed water through a pipe which runs along the interior of the boiler and bends down to the centre of the boiler at the sides almost directly under the sand box.

The smoke stack barrel is smaller at the top than at the bottom. This stack, though contrary to the customary practice in the United States, seems to give excellent results on the Canadian Pacific Railway. The pilot braces are attached to the pilot in a superior manner, having four bolts through a broad foot, a heel being turned upon the brace. The rear end of the pilot braces are ingeniously attached to the fulcrum pin of the front equalizer. The truck is well mounted on coil springs in such a manner as to remove all obstructions from above the truck which are liable to interfere with the frame. This construction enables the lower end of the frame to be carried over the truck to the front bumper. This is the form of truck used on the fast mogul locomotives on the "Q" road and is a favorite form at the present time. In this particular design the swing links have an unusually long bearing.

Cast-steel valve motion links are being used with considerable satisfaction in the place of case-hardened wrought iron ones, and the locomotive here illustrated is fitted with such links, and they seem to wear well and are easily repaired. All bearings throughout the link motion are furnished with hardened steel bushing. This is slightly more expensive at first, but the additional cost is more than compensated for by the reduced cost of repairs.

There is about this locomotive an appearance of balance that is, the details in sight have no unusual angles, the various parts seem to be located so as to reduce the appearance of complication. Thus the air-brake cylinder is placed directly over the driving axle, the rocker arms are in line with each other, the reverse shaft arms are at right angles, and throughout the engine there seems to be a parallelism and superimposition of parts which gives this locomotive the appearance of simplicity and the avoidance of unnecessary parts. This is a point well worthy of attention from locomotive designers. Almost invariably engines can be improved in appearance by better arrangements of the parts which would in no way interfere with the operation of the mechanism.

Solid end rods for six-wheel coupled engines are evidently not in favor on the Canadian Pacific, although giving good satisfaction in many cases. The eccentrics are made in halves bolted together. The smaller parts of these divided eccentrics being made of hard brass. The bearing surface of the eccentrics are 4 in. wide. This is an unusual width, and in this design, there being no reason for using the customary narrow eccentric, the departure is commendable. There is one feature about this engine which is worthy of attention. It is the lightness of the reciprocating parts. For the size of the engine the combined weight of the solid piston head, steel piston rod and cross-head and steel connecting rod is somewhat less than usual, and materially assists in counterbalancing the locomotive.

The fire-box ring corners are extended downwards on the inside in order to secure another row of rivets at this point to which to attach the inside fire-box sheet at the corner only. This is a practice followed by the Chicago, Milwaukee & St. Paul for several years, and it is considered as being an improvement by those who have tried it on locomotives using inferior feed water. In this design of locomotive, in order to obtain room for the fire-brick arch and to obtain a sufficient depth for the fire at the front end of the fire box, the top rail of the frame is dropped about 6 inches. A large oil hole is cut through the equalizers over the driver boxes. This is almost the only instance where this opening for the oil can has been made large enough to be of real service. Ordinarily the oil is poured between the frame of the equalizer in large quantities in order that a little of it may reach the top of the driving box.

It is pleasing to note the absence of the numerous and unnecessary attachments between the boiler and frame so frequently seen in engines of this class. Only one vertical and lateral attachment is found, and that is where it belongs, at the fire box ring. Several progressive locomotive designers have omitted from their locomotive design all of the braces known as gussets, waist and belly-braces which unnecessarily disfigure and complicate the construction. Not only are such braces useless, but in long locomotives they increase the chances for hot driving boxes by forcing the boxes hard against the wheels on curves; this results from the reduction of the lateral flexibility of the framing. There are many points of interest in the boiler, ash-pan, motion work and running gear, as well as in the trimming of this locomotive, but the completeness of this illustration makes such points sufficiently evident to render further mention unnecessary.

The Forney Car Seat Improved.

Some recent improvements in the well-known Forney car seat are shown in the illustrations herewith. The principal object of these improvements is to do away with the obstruction underneath the seat, offered by the foot-rests and the frame which holds the seat in the ordinary construction. These parts, as almost always constructed, make it difficult to scrub or sweep the floors thoroughly under the seat.

In fig. 1 is shown the improved form of the Forney car seat in perspective, and in fig. 2 are shown the seat and foot-rest raised up, and the back turned half-way over, in the position for cleaning the car. It will be seen that the stand at the outer end of the seat is entirely self-supporting, and the seat is suspended on the pivots at either end in such a way as to do away with the frame which has been heretofore used. The foot-rests are supported in various positions by pawls which engage in ratchets fastened to the floor, consequently they can not only be turned up out of the way, as shown in fig. 2, but the height of either foot-rest can be regulated to suit the convenience of the passenger. The two pawls on each foot-rest are connected together, so that when one is raised or lowered the other moves with it. When the parts are in the position shown in fig. 2, one of the foot-rests engages with a slat on the under side of the seat, and in this way all the parts are supported in the position shown, thus giving free access under the seats for cleaning the floor.

The absence of any cross frame leaves clear space enough underneath to receive a valise or other small baggage, and it is suggested that a receptacle for hats, coats or other objects can be attached to the under side of the seat.

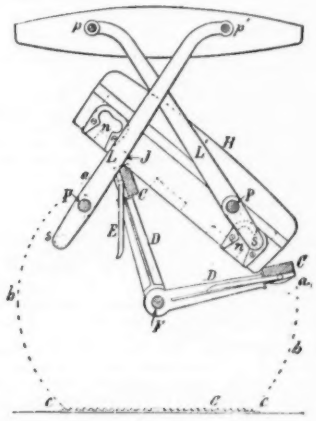


Fig. 2.

One object that has been borne in mind in the design of the Forney seat is to place the arms so low as to be comfortable for the passenger. In the ordinary arrangement of car seats the arm rests are almost universally too high. The mechanism of the Forney seat permits these to be placed as low as is desired. For various reasons it is not desirable to lower the window sill to such a position as to make it comfortable for an arm rest. Therefore, the method of construction shown in fig. 1 has been devised. The window ledge is placed 24 in. above the floor, and under it is a recess or pocket affording a ledge wide enough for a comfortable arm rest, and which can be used as a shelf to hold books or packages. The mechanism for supporting and reversing the seat and back is now well-known and is so clearly shown in the illustration as to require no further explanation.

Some Results with Secondary Batteries in Train Lighting.*

BY ALEXANDER S. BROWN.

It is now four years since the Pennsylvania Railroads, appreciating the advantages of electric train lighting, began a series of experiments with the secondary battery, for the illumination of parlor cars. I am unable to give the cost of lighting by any of the batteries referred to, as the expense appears to have been a secondary consideration compared with the necessity of securing the best system of illumination.

The first experiments made by the company were with the Faure accumulator, which was brought to this country from France in the spring or early summer of 1882, and put on passenger coach No. 397 in August of that year. The car was run for a few days only, but enough was learned in that time to show that the lighting of cars by secondary batteries was perfectly practicable, when a modified form of the battery could be obtained.

During the summer of 1884, experiments with the Brush storage batteries were commenced at the Altoona shops of the Pennsylvania railroad, and continued through the fall and winter of that year. These experiments were made by Dr. Dudley, and proved so successful that eight parlor cars,

*A paper read before the American Institute of Electrical Engineers, New York, May 22, 1889.

which were being constructed at that time, were equipped for incandescent lighting and put into regular service on the 1st of April, 1885. The Brush cells used consisted of three plates each, two negative and one positive, the amount of surface of the positive plate being equal to that of both the negatives. These plates differed from those now used, there being no paste in their composition. The negative plate was designed to give the greatest possible amount of surface from the least weight of material. The positive plate measured 8″ × 9″ × 1″ and the negative 8″ × 9″ × 1/2″.

These batteries are rated at 70 ampère hours, but the hard usage they received soon reduced their capacity, and at the end of a year's time the positive plates were almost entirely destroyed. * * * I allude more particularly to the positive plate. The weak points in the Brush battery were the small number of ampère hours per pound of material—about two I believe. There was a tendency to buckle and sulphate, and the arrangement for connecting the plates was such that there was oxidation at the junction, causing the plates to break when subject to the motion of the car. This last feature was a source of endless trouble to us, and as is usually the case, was sure to happen at a time or place where it was impossible to repair the break. While using the Brush battery the cars were wired with the battery boxes, one on each side of the car, coupled together in series, each box holding three trays, and each tray containing four cells, this giving a total of 24 cells to a car, or an E. M. F. of 48 volts. The lamps used originally were of the Brush-Swan type, with small platinum loops projecting from the base, these hooking into a socket, and held in place by a spiral spring, this socket fitting into another one, to which the connections to the wires were made.

After using this style for some time an improved pattern of Brush-Swan lamp was substituted, but the great drawback to this lamp was its frailty, the breakage per day often averaging 4 per cent. of the total number of lamps in use on all the cars. These lamps required about 45 volts and 1 ampère of current, and each car contained 10 lamps, 7 in the body, 1 in the smoking-room and 1 in each vestibule, thus using about 10 ampères of current, and as the batteries were rated at 70 ampère hours, we should have obtained from 6½ to 7 hours good light, but it was very seldom, after the batteries had been used for a short time, that we could get over 5½ hours. As will readily be seen, this could hardly be called economical, for to obtain 5 or 6 hours' light we were obliged to charge from 15 to 20 hours with a Brush arc light dynamo giving a current of about 10 ampères. Then taking the weight into consideration, each time the car needed charging, the trays, 6 in number, and weighing 1,200 lbs., had to be loaded on the truck, pulled over to one side of the car, and the discharged trays taken out and the freshly charged ones put in their place. The remaining three were then taken around to the other side of the car and changed in the same manner. As the cars invariably stood on a double track it was necessary to carry half the trays for some distance, over tracks, etc. Then, again, the tracks were usually full of cars, and if there was not sufficient time for them to be parted the batteries had either to be carried under the car or over the platform. Under the present system this has been done away with to a great extent, as will be explained subsequently. During the month of December, 1886, we commenced using one battery of the 7 B type, manufactured by the Electrical Accumulator Co. This battery was a decided improvement over those previously used, giving as it did nearly double the number of ampère hours for the same weight of material. After using this battery for about a year the positive plate began to give way and new ones were substituted, the negatives, however, being retained, they not having deteriorated. In fact, we are still using the negative plates of our original 7 B battery. This battery proved to be so satisfactory that in June, 1887, we added two more of the same type and two manufactured by the Julien Electric Co. The latter batteries were similar in size and shape to the 7 B type of the Accumulator Company, but did not seem to stand the hard usage so well, as they would crack instead of buckling, and allow a large quantity of the paste to become loosened and fall out. It is proper to state, however, that these plates were made especially for us to fit the cells we were using, and were not of the regular Julien type. This, no doubt, will account in a great measure for their failure to keep up to the standard of the present type of Julien batteries. After the positive plates of this battery became worthless, and not having any others to put in their place, we decided to make a kind of consolidated affair and see how Julien negative and Accumulator positive plates would work together. The result was extremely satisfactory, and we have had no trouble with them whatever, excepting the occasional buckling of a positive plate.

During the fall of 1887, we began substituting the accumulator batteries for the Brush batteries, and by the end of the year we were using them altogether, with the exception of the two Julien I have mentioned. We, however, kept 96 of our best Brush cells to be used in case of an accident to the incandescent dynamos, which are used to supply the current for the railroad telegraph as well as for lighting the passenger station.

After the change in batteries had been made, it was thought best to change the system of wiring the cars, so that instead of its being necessary to put batteries on each side of the car, we need only put them on one side, and get the same amount of light. This was done by connecting the two boxes under the car in parallel, and substituting 23 volt Edison lamps for our 45 volt Brush-Swan lamps. After doing this we found that we were able to get as many hours' light from 12 cells as we formerly did from 24. Of course this change reduced the expense of lighting the cars considerably, for where we formerly had a change of battery for each car, or 48 cells, we now needed only 24 cells per car, with a few extra ones to be used in case the 12 cells would not be able to supply sufficient light for a long trip. This system of lighting proved so successful that it was decided to substitute it for gas in the remaining seven parlor cars. The wiring of these cars was commenced at the Meadow shops, near Jersey City, last September, and has just been completed. These cars are arranged for the 23 C type of the Accumulator Company's battery, and 19 B type of the Julien battery. The battery boxes under the cars are larger than the old style, and contain four trays or 16 cells, the lamps we used taking 23 volts E. M. F. Changes were also made the first of the year in the system of charging, and the batteries are now charged from an incandescent dynamo instead of an arc, thus enabling the batteries to be charged with any amount of current desired. In connection with this description of the four years' work of the Pensylvania Railroad, I would like to add something in regard to the electric lighting of the Chicago limited express.

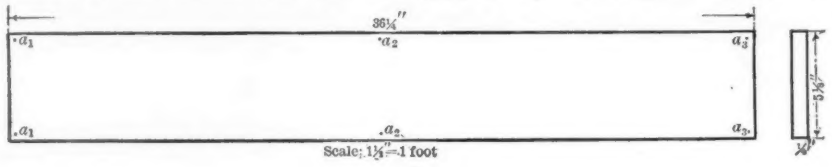
In 1887, the Pullman Palace Car Co. commenced using the electric light on one of three trains of the New York & Chicago limited express, and the charging of the batteries at Jersey City was given into the hands of the Pennsylvania Railroad Co. The batteries used were the 7 B type of the Electrical Accumulator Co., 30 cells to a car, and usually there are six cars in the train. These batteries would furnish enough light for one trip, and each time the train arrived at either terminus it was necessary to replace them with freshly charged cells. This was not objectionable at Chicago, for the train arrived there in the morning, so that they could be charged during the day, but in Jersey City, where the train did not arrive until evening, the work was very difficult on account of the dynamo being in use for other purposes. After this one train had been running a short time, another one was fitted up, 19 B type of Julien battery being used. It was thought that this would give us a chance to see which was the better of the two batteries, but they both worked very well considering the treatment they received. After Mr. Bauer became connected with the Pullman Co., he did away with charging the batteries at the ends of the line, and introduced a Brotherhood engine and Eickemeyer dynamo in the baggage car of each train, in order that the batteries might be charged in transit. The batteries are charged continuously from Philadelphia to Chicago, and the same practice is continued on the return trip. The steam for driving the Brotherhood engine is taken from the locomotive boiler, and the exhaust is used for heating the train.

So far as the Pennsylvania Railroad is concerned the electric lighting of passenger trains may be considered an assured success, and leading as it does to the abolition of kerosene lamps, and incidentally encouraging the adoption of steam heating, the safety and comfort of the passenger is certainly increased.

Expansion of Timber Due to the Absorption of Water.*

Having had occasion to use the facts in regard to the expansion of timber in the direction of its fibres, and failing to find, after a limited search, definite figures, I prepared a specification for the Department of Tests in Stevens Institute, according to which the results in the following table were reported.

The specification directed that two specimens each of pine, oak and chestnut, each about 3 ft. long, and 6 in. wide should be selected, of good quality, fairly straight grained, free from knots and fairly seasoned. The specimens were then to be kept in a dry warm room for about three weeks.



Class of Wood.	Pine.		Oak.		Chestnut.	
No. of the specimen	1	2	3	4	5	6
Longitudinal Measurements.						
Initial length aa inches	35.545	35.665	35.620	35.525	35.625	35.540
Final length aa inches	35.565	35.680	35.645	35.560	35.695	35.585
Elongation, inches	0.020	0.015	0.025	0.035	0.070	0.045
Per cent. of elongation	3/50	3/200	1/100	1/10	1/5	1/100
Transverse Measurements.						
Initial a_1a_1 inches	4.500	4.470	4.485	4.480	4.505	4.480
Initial a_2a_2 inches	4.495	4.450	4.475	4.440	4.470	4.470
Initial a_3a_3 inches	4.460	4.450	4.485	4.420	4.485	4.475
Mean	**4.485**	**4.456**	**4.482**	**4.447**	**4.487**	**4.475**
Final a_1a_1 inches	4.620	4.580	4.635	4.625	4.695	4.635
Final a_2a_2 inches	4.615	4.555	4.645	4.570	4.635	4.615
Final a_3a_3 inches	4.580	4.570	4.685	4.560	4.660	4.635
Mean	**4.605**	**4.568**	**4.655**	**4.585**	**4.663**	**4.628**
Expansion inches	0.120	0.112	0.173	0.138	0.176	0.153
Per cent	2.7	2.5	3.9	3.1	3.9	3.4
Rate of expansion / Rate of elongation =	45	59	56	31	19	25
Mean	**52**		**43½**		**22**	

Eight brass pins were to be inserted, one near each of the four corners, two near the middle of the length and near the edges, and two near the middle of the width and near the ends. The arrangement of the pins and general dimensions of the specimens are shown in the annexed figure, drawn 1/8 of full size.

A very small mark was made on each pin with a centre punch to facilitate accuracy of measurements. These were on one side only of the specimen, and the readings were to the nearest half hundredth of an inch.

The report states that the specimens were, according to the specification, kept in the office for three weeks, when the initial measurements were made, after which they were immersed in water June 7, 1888, and removed from the water July 14, having been in the water 37 days, and the final measurements made on the latter date.

The record is as follows:

The mean per cents of elongation were

	Pine.	Oak.	Chestnut.
Elongation, per cent	0.06½	0.08½	0.16½
Of lateral expansion, per cent	2.6	3.5	3.65

It will be seen that chestnut expanded more than the pine or oak both transversely and in the direction of the fibre; that the mean elongation of the chestnut was 2.6 times that of the pine, and the lateral expansion was 1.4 times as great as that of the pine.

* By De Volson Wood, Hoboken, N. J. Read at the Erie meeting of the American Society of Mechanical Engineers.

Double Strength Culvert Pipe.

Among the topical questions discussed at the fourth annual meeting of the Illinois Society of Engineers and Surveyors was the following: Is it necessary to use double strength culvert pipe for culverts, or will ordinary sewer-pipe be strong enough?

The discussion is here reprinted nearly in full from the published report:

I. O. Baker: According to experiments (not by the writer) made by bedding the lower half of the pipe in sand and applying a pressure *along a comparatively narrow area*, the average crushing strength of ordinary sewer-pipe was 2,400 lbs. per sq. ft. of horizontal section, and for culvert pipe is 12,000 lbs. per sq. ft. If the pressure had been applied more nearly as in actual practice, the pipes would have borne considerably more. The first of the above results is equal to the weight of 24 ft. of earth, and the second to that of 120 ft., although actual embankments of these heights would not give anything like the above pressure. The writer is making preparations for an extensive series of experiments on the strength of culvert and sewer-pipes. The only danger of vitrified pipes being crushed is from the expansive force of frost. There is a little difference between culverts and sewers in the exposure to frost; but no danger need be apprehended from this cause, *provided* the culverts are constructed so that the water is carried away from the lower end, since ordinary soft drain tile are not in the least injured by the expansion of the frost in the earth around them.

J. M. Healey: In the construction of roads it has been common to use the vitrified glazed sewer pipe. It has often been laid without protection for the ends, and in many cases has resulted in total failure; the ends have been thrown up by the frosts, leaving a low place at the centre for water to collect and freeze, which has invariably broken and ruined the pipe.

The question is, Can vitrified glazed sewer pipe be used successfully for railroad culverts? And is the "double strength pipe" any better than the other? Is it any less liable to be broken by the frost? On this part of the Illinois Central Railroad, where it has been used only in a few cases, it has been a failure. The first case is where a 2-ft. pipe was laid in 1878 under the main track just south of Loda station. Special pains were taken to have it properly laid, to give it sufficient fall, and to have the ends protected from the frost as well as they could be, etc. The first two years it was watched carefully, and there being no breaks, it was supposed to be a success. It was not till after the extreme cold weather in the winter of 1884 and 1885 that two or three pieces were found broken, then the next winter (being very cold) more of the pieces were broken, and in 1888, when it was renewed with iron pipe, all the pieces were found broken. The damage was done in midwinter, when the water was frozen as it was flowing through the pipe.

Another case is where an 18-in. vitrified glazed pipe was laid under the main track north of Champaign station in 1883. It was in the prairie where there was but little fall to the stream. There was 8 feet of earth over the pipe. Great care was taken to have it properly laid, so there would be a good outlet, and since that time the ditch has been kept well cleaned, and yet to-day nearly every piece of the pipe is broken.

Another case is where a 2-ft. glazed sewer pipe was laid in the city of Champaign for sewerage purpose on Main and Walnut streets in 1872. It has been a success in every respect, except that at the outlet 8 or 10 ft. of the pipe has been broken by the frost. As far as could be seen, everything was done in laying the pipe that could be done to prevent its breaking. There was sufficient fall, and there was no water allowed to stand in the ditch at the outlet. The bottom part of the pipe was frozen and broken with the damp earth or clay under it.

It is possible that a pipe could be used successfully, through a railroad embankment, if the joints could be laid in cement and a bed of sand or gravel (with a good drainage) used under the pipe. If it cannot be kept from breaking in this way, it could not be depended upon in time of need.

We have not used any of the double-strength culvert pipe. Where there is not much pressure and no frost, the vitrified glazed pipe can be made to answer a very excellent purpose; but where there is frost, the pipe of single thickness is not safe, and it is very doubtful if the double-strength pipe would be any better. I prefer cast-iron pipe.

S. F. Balcom: The pipes in a culvert in the I. C. R. R. after removal were found to be sound except those immediately under the tracks and they were all broken. There was 2 ft. of earth under the track.

Mr. Baker: There must be enough earth—at least 3 ft.—for a cushion above.

E. A. Hill: We used a good deal of culvert pipe on the I., D. & S. road. The durability of the pipe depends more in the manner of laying than anything else. If you have them bedded well the pipe will last well. I do not know of any cases of failure on account of crushing.

Mr. ROTTMAN: We have Blackmer & Post's 2-ft. pipe in the water-works at La Salle and they last well.

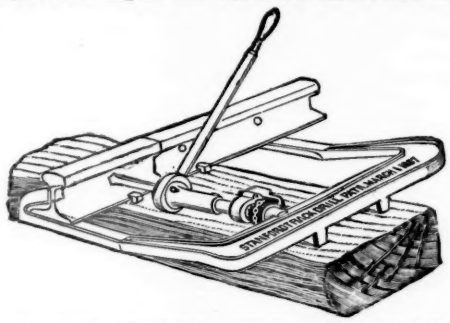
Mr. BALCOM: If water stands in pipes the danger from frost is considerable. As to the amount of frost necessary to break a common pipe I have found that water 4 in. deep standing in a 2 ft. tile, froze and broke it.

Mr. STANFORD: The cause of breakage is worthy of examination. Some that I took up once were broken into four pieces longitudinally. I had no time then to investigate. What is the cause?

Mr. BELL: An 18-in. sewer was laid here in Bloomington in November one year. The ground for filling trench was frozen when put in. As soon as all was done a hose was turned on and the trench flooded. The sewer failed to work and on removal for reconstruction it was found that every pipe was broken.

The Stanford Track Drill.

The track drill which is here illustrated is a comparatively recent tool, which is put on the market by Fairbanks, Morse & Co., of Chicago. It has an interchangeable automatic and hand feed. The automatic feed of the bit makes a uniform cut, which not only facilitates the work, but diminishes the danger of breaking the bits. The drill bit carrier has a steel



friction clutch. The working parts are well protected from dirt, and the frame is placed entirely above the rail, so as to be out of the way of passing wheels, as is now the common practice in the best devices of this sort. All the holes for one joint may be drilled without moving the frame.

Cover Stones for Box Culverts.*

In discussing the proper thickness of cover stones for box culverts Prof. I. O. Baker, of Champaign, Ill., said:

The relation between the thickness of the cover (when of average sandstone) and the weight of the earth over it is given by the simple formula

$$T = 0.25\, S \sqrt{H} \quad \ldots\ldots (1)$$

in which T is the thickness of the cover in inches; S the span in feet; and H the height, in feet, of earth over the cover. For average quality limestones use 0.20 instead of 0·25 as in the formula. If the culvert is under a railroad, the relation between the thickness and weight of bank and train is given by the formula

$$T = 0.25\, S \sqrt{H + 5} \quad \ldots\ldots (2)$$

However, the thickness of the cover stones does not depend alone upon the depth of the earth, the live load and the span. In the *first* place, the pressure on the cover does not vary directly as the depth of the earth above it. (*a*) The earth itself acts more or less as a beam to support part, at least, of the weight over the opening. (*b*) The prism of earth directly over the culvert will be partially supported by the adjacent soil; that is to say, the particles of earth directly above the culvert will act more or less as arches resting upon the earth at the side of the culvert, thus partially relieving the cover stones. (*c*) The stones at the centre of the culvert would be relieved of part of their load by an action, similar to that mentioned above, whereby the weight over the centre of the culvert is transferred towards the ends. In the *second* place, the pressure due to the live load is transmitted downward in diverging lines. Hence the weight of the live load is distributed over so great an area as to make it inconsiderable. In the *third* place, the cover must be thick enough to resist the effect of frost as well as to support the earth and live load above it.

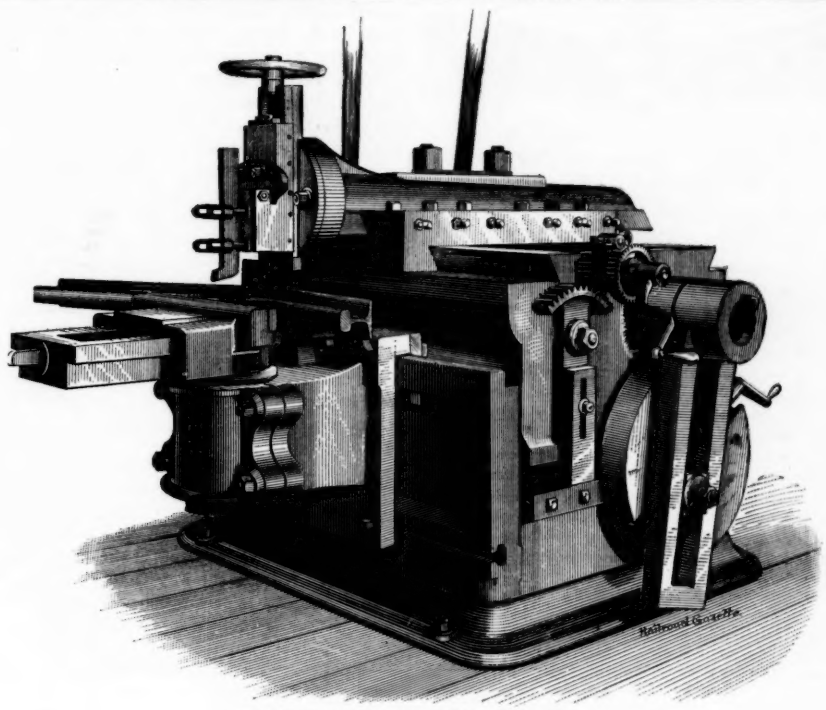
It is impossible to compute, even approximately, the effect of the preceding factors; but experience shows that the thickness is independent of the height of the embankment, *provided* there is sufficient earth over the cover to prevent serious shock, say three feet for railroads and one to two feet for highways. The thickness employed on the railroads in states along the fortieth parallel of latitude is generally about as follows:

Span of culvert.	Thickness of cover.
2 ft.	10 in.
3 ft.	12 in.
4 ft.	15 in.

On the Canadian Pacific R. R., the minimum thickness of cover stones for spans of 3 ft. and over was 16 in., and under 3 ft. 14 in.

Mr. W. D. Clark, of Springfield, said: I oppose the use of stone covers for box culverts, for it is very treacherous, as stone lintels over wide openings in buildings demonstrate. In architectural construction the greatest care is required to secure the least possible weight on the centre of the lintel, and if possible relieve the stone of any weight except over the bearings. Stone over box culverts carries the weight of the embankment, and is in almost constant danger of breaking in the centre, especially if the stone is not perfectly sound. A brick arch is less expensive in many localities, and if properly constructed is absolutely safe. I indorse Prof. Baker in his plea for brick construction, as I never would use stone unless absolutely compelled to.

* Abstract of a topical discussion by the Illinois Society of Engineers and Surveyors.



EIGHTEEN-INCH SHAPING MACHINE.

Made by the KANSAS CITY SWITCH & FROG CO., *Kansas City, Mo.*

Eighteen-Inch Shaping Machine.

The shaping machine shown in the accompanying illustration is made by the Kansas City Switch & Frog Co. This machine is designed for heavy work, and to meet the demands of railroad switch and frog works. The bearings and all the parts liable to excessive strains have been increased until it is a very powerful shaping machine and at the same time capable of doing work of fine finish.

The driving gear and pinions are of cast steel, and the crank pins of hammered crucible steel. The feed screws are of machinery steel. The slide has a movement of 6 in. The head and apron are both swiveled. The carriage has a maximum movement of 3 ft. and 4 in. The vise has a side movement of 32 in., and can be adjusted to any angle. The feed is automatic, and can be easily arranged to be operated by hand.

One of the principal improvements in this machine is the vise, which is designed to grip and clamp the work quickly. The jaws of the vise are faced with steel, are made 4 in. deep and 24 in. long, and will open sufficiently wide to receive work 16 in. in width. This machine is furnished with a cone having steps wide enough to receive a 5 in. belt, and in operation it will remove a chip from cast iron 1½ in. wide and $\frac{3}{64}$ of an inch thick, which gives evidence of the great strength and rigidity of the parts.

There is a demand for this class of tool in railroad work; a tool which can do rough, quick work is essential to the economical manufacture of many parts connected with the track and bridge departments.

Forced Draft.

There are three general methods of producing forced draft. The oldest plan is a jet of steam admitted into the smoke-stack, near the base, through an annular pipe pierced with small holes. This system, in addition to the fact that it is not the most efficient, causes a considerable loss of fresh water, which is a serious matter in the case of ocean steamers. The second method consists in discharging through pipes the current of air produced by a blower into the closed ash-pits of boilers. There are several systems of this kind, among others those of Messrs. Fothergill and Howden, in England, and that of the General Transatlantic Co., of France.

In the Howden system, a box of thin iron, designed to receive the air from the blower, is secured to the boiler front, completely enveloping the furnace and ash pit, and there are valves which control the admission of air into these parts. The furnaces have double doors, the external doors being fitted air tight. Air admitted between the doors can be discharged upon the surface of the incandescent flame through holes in the internal door. In this system the heat in the products of combustion is utilized in part to warm the air supplied for combustion, which passes, after leaving the blower, around tubes traversed by the products of combustion on their way to the smoke-stack.

The third method is known by the name of *closed fire-room*, the fire-room being air-tight, and the air required for combustion being delivered into the closed space under pressure. This system, which has been used for iron-clads, torpedo-boats, war ships, has some defects. Although the fire-room is well ventilated, the firemen are perhaps too much isolated in case of danger. Another inconvenience arises from the fact, that when a furnace door is opened, there is a rush of cold air into the furnace which strikes the fire box, the tube-head and the tubes themselves, frequently causing cracks and leaks.

The system of forced draft in close fire-rooms has rarely been applied to merchant steamers, until quite recently, and the steamer "City of New York" presents a good example of the application. On this steamer 12 powerful blowers force air into closed fire-rooms, and the employes enter each of these rooms through a shaft opening into a passage on the spar-deck, which passage, having two air-tight doors, forms an air lock. The shaft contains a hydraulic elevator, but there is only room for two men at a time in the air lock, so that in case of a collision or other accident, the firemen would be exposed to great danger.

The system employed by the General Transatlantic Co., of France, is much more simple than Mr. Howden's, described above. It consists in delivering the air from a blower into a pipe which is under the fire-room floor and runs parallel to the boiler fronts. To this pipe there are connected branches leading to the boiler fronts a little below the ash pit door. These pipes are arranged to deliver the air under the grates. When a furnace is to be fired or a fire cleaned, the opening of the furnace door closes automatically the branch pipe which conducts the air to that furnace and opens it again when the door is closed. The blower is placed in the fire-room and derives its supply from that room, thus continually renewing the air much more effectually than is done by ordinary ventilators and wind-sails.

Much of what is said here is condensed from the *Revue Général de la Marine Marchande*, which journal recently published an interesting article on the subject written by Mr. G. Brunel.

THE SCRAP HEAP.

Notes.

The New York Central gave out last week contracts for about one million tons of coal, of which Bell, Lewis & Gates, of Buffalo, were awarded 400,000 tons, said to be one of the largest single contracts of the kind ever made in this country.

A freight train on the new line of the Canadian Pacific through Maine was delayed several hours recently by an army of caterpillars, which swarmed upon the track faster than a large force of men could sweep them off. Sand was used to no purpose.

The Order of Railway Conductors, which has recently held a protracted convention at Denver, Col., has decided to establish permanent headquarters at Sioux City, Ia., and will erect a building costing $200,000. The citizens give the conductors $75,000 in cash and make other guarantees.

John Ericsson.

A Washington dispatch states that it is a fact that when the "Chicago" is ready for sea she will take on board the body of Captain John Ericsson and carry it to Sweden for burial.

Aluminum in Pittsburgh.

The Pittsburgh Reduction Co. have now put their product on the market, and the *American Manufacturer* gives it a quotation among the other products of that city. The price opens at $4 per lb. for ingots and $6 to $8 for plates. It is said that the Reduction Co. hope to so perfect their methods and increase the demand for aluminum that they can reduce the price to the neighborhood of $1.

Colored Passengers on Southern Railroads.

Referring to the recent decision of the Inter-state Commerce Commission upholding the rights of colored passengers, the Mobile *Register* says: "Southern people of refined sensibilities and with proper ideas of justice and decency, have long regarded with impatience and disgust the way in which our railroad corporations take the money of colored people and consign them to what is often little better than a hog pen." The Macon *Telegraph* commends the decision of the Commission.

Heraldic Art in the Wild West.

The Chicago, St. Paul & Kansas City offers a prize of $100 to the ticket or passenger agent who shall design an acceptable trade-mark for the passenger department of that road.

RAILROAD GAZETTE

Published Every Friday,
At 73 Broadway, New York.

EDITORIAL ANNOUNCEMENTS.

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particulars as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting, and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

In this issue is illustrated a recent design of mogul engine, by Mr. Francis R. F. Brown, Mechanical Superintendent of the Canadian Pacific Railway. This design of locomotive presents some new and attractive features. Several innovations are pointed out in the description. The reader will notice that the smoke-box arrangement used is, in some respects, contradictory to what is considered by many as the most successful design in American railroad practice. Yet, in spite of this, the locomotives illustrated are giving good satisfaction. This goes to show that it has not yet been determined what are the essential features of locomotive smoke-box and smoke-stack designs, and that no one design or arrangement of parts is superior to all others, or embodies all of the principles necessary to success, but that success may result from the proper combination, in many ways, of the various details which enter into smoke-box construction. Probably there is more conflict of opinion concerning smoke boxes and exhaust arrangements than with regard to any other details of locomotive design.

A number of letters have been received since the publication in our issue of April 26 of an editorial on rail joints, taking exceptions, as does that from Mr. Blackinton, published in another column, to what was said about the long angle-splice joint. We suggest that the writers read that editorial again somewhat more carefully. It is not by any means said or implied that the three-tie angle splice is "about perfect." No attempt was made to close the subject in favor of an angle splice joint, but merely to sum up briefly the present situation. The statement was made that with the three tie joint of recent heavy sections, breakages have practically ceased; that it is evidently giving better service and satisfaction than the suspended joint; that there are good apparent reasons why it should do so, and on the whole the impression conveyed to most readers was probably that it is the best form of joint yet subjected to wide and severe trials. Since that writing we have been told of something over 2,000 six-bolt splices broken under heavy service in first-class track. These were heavy angle splices of about 2.75 and 3.5 sq. in. area in cross section, but they were used suspended, and consequently the results from them do not apply strictly to the form of joint which we find on inquiry to give most favorable results. In the same article mention was made of a joint that was used experimentally on a Western road for some years and which was designed to do precisely what Mr. Blackinton asks for. That is, to carry the wheel across the opening between the ends of the rails. This joint was tried on the New York, Pennsylvania & Ohio, and consisted of a piece of rail, probably about 24 in. long, with the head and flange planed off on one side so as to fit close up against the track rail on the outside, and bolted fast by four bolts through the webs, with a fish-plate on the inside. Four of these joints were put in, according to one authority, in 1878, and according to another in 1880, and they remained in the track until the rails were changed in 1888. During those eight or ten years the joints were kept in good condition without any repairs, except to tighten the bolts occasionally, and gave good satisfaction, except that they were said to be hard on hollow wheels. It was the wish of Mr. Latimer to try a mile or two of this joint, but he could not get the mill men to make a set of rolls for a small order, and the road was not in condition to make extensive experiments. It is suggested that the criticism against this form of joint, that it is destructive to hollow wheels, is not a valid one, as a wheel with the tread so badly worn as to cause a severe blow on striking the joints would be unsafe to run over frogs and split switches. As was said before, the essential principle of this joint has been incorporated in one recently patented.

The inquiry of the Inter-state Commerce Commission, on complaint of the Chicago Board of Trade, concerning relative rates on live hogs and packing house products, shows some of the difficulties involved in government control of railroad charges. As to the fundamental basis of complaint, there can be no question. It is based on the fact that the packing business of Kansas City and some other Western points has been growing at the expense of Chicago. What to do about it is not so clear. In the first place there may be other causes besides railroad rates which have produced the decline. We are told that the question was asked whether there was not an agreement between the packers to the effect that a portion of the packing houses should remain closed and receive a percentage of profits; that two witnesses refused to answer, and that one answered in the affirmative, and that this "created a sensation." We also find that the Western packers regard themselves as the real defendants in the case. They claim that the difference is of long standing and offers no disadvantage to Chicago. Finally come the various points of railroad economy, as to relative cost of live and dressed meat. If the Commission masters half the facts in the case, it will do well. We fear, however, that all that can be done will hardly leave the result in a more scientific shape than it was under the old system of free competition.

The refusal of the Board of Arbitrators of the Interstate Railway Association to allow the request of the Alton for a ten cent rate on lumber from Chicago to Missouri River points will test the resources of the organization. It may be taken for granted that the Alton will not rest content with the refusal. Two alternatives are open. Either the Association must "take such steps as may be legal, necessary and proper to secure to the company a share of the competitive traffic," or the railroad company must withdraw from its agreement. The first alternative would at once force the settlement of a delicate question of interpretation. How to produce the effects of a pool without violating the law against pooling is not an easy matter to decide. When the clause above quoted was under discussion, in the meeting for organization, a great many railroad men were extremely anxious to know what it really meant. Their curiosity was not satisfied. In fact, they were told that they had better not ask too closely. It was thought that it would be time enough to find out what was meant after they had signed the agreement, and when they began to quarrel over it. Such a postponement of the trouble could not be permanent. But it was hoped that it would last long enough for people to get used to the workings of the new association. A serious conflict with the Inter-state Commerce Commission at this moment would be disastrous; and any interpretation of the agreement which could promptly meet the present difficulty would be likely to cause such a conflict. Under the circumstances, it is almost certain that the authorities of the association will regard it as the less of two evils to allow the Alton to withdraw. The direct effect of such withdrawal will not be very great. The Illinois Central never was in the association; it therefore makes less difference whether the Alton stays in or goes out. The indirect bearings of the case are more serious. If the first trifling dispute results in the withdrawal of a road, what will happen when more serious matters come under dispute? The precedent is a bad one for the future. Not without reason did Commissioner Walker refuse to accept the chairmanship of the association until he was offered a guarantee of a three years salary, whatever happened.

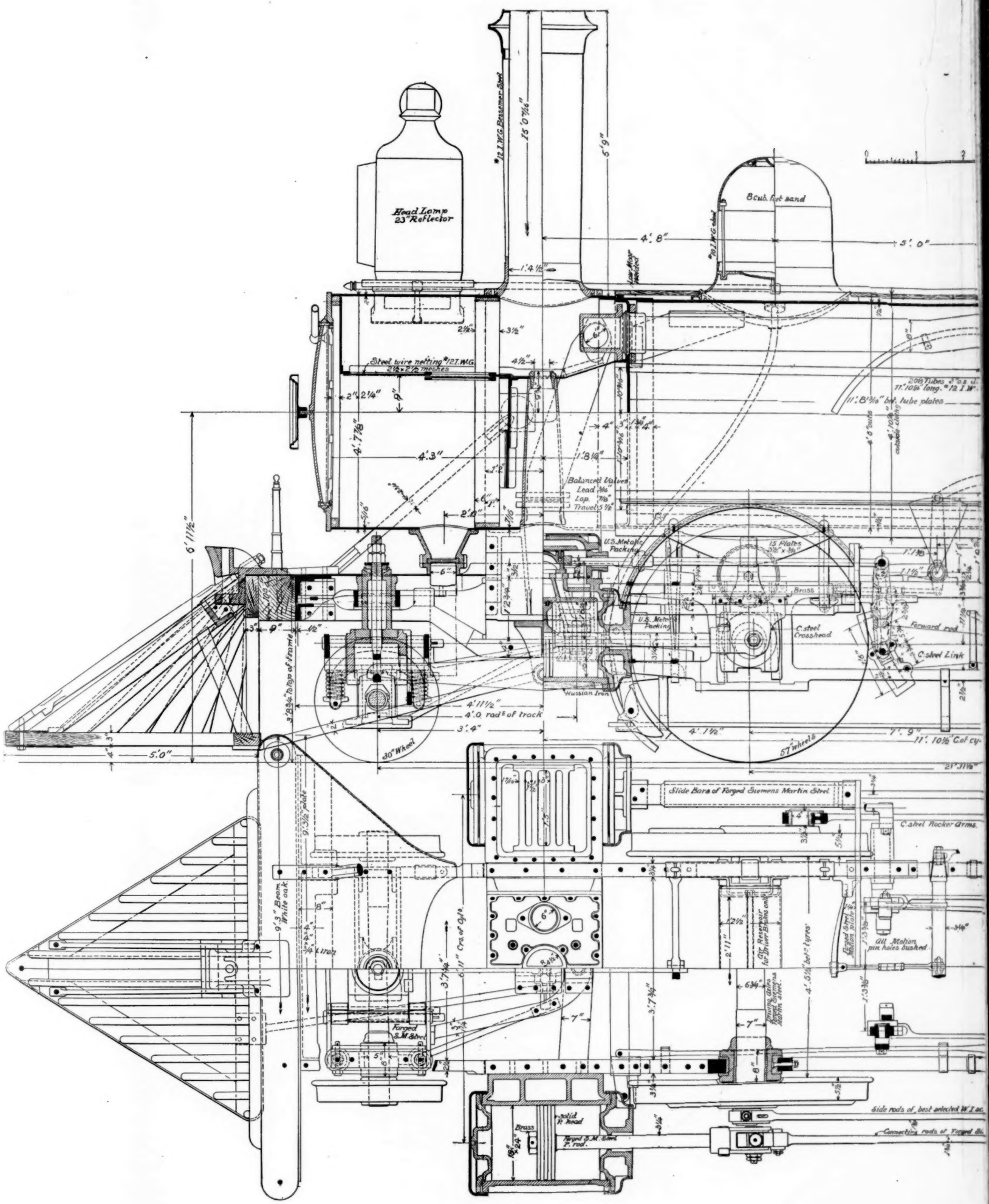
The New York Railroad Commissioners have made a decision which looks like an attempt at equal mileage rates. The Buffalo Merchants' Exchange complained because rates from Chicago to Buffalo *plus* those from Buffalo to New York were greater than those from Chicago to New York direct. The Commission recognizes that it cannot do anything, but it strongly urges the railroads to make the reduction asked by the merchants. Of course this is out of the question. If the principle of the complainants were admitted, goods which are rehandled in transit at Buffalo would have to take the same rates as those which went from Chicago to New York direct. It may be urged that the case of grain milled in transit furnishes an instance of just this kind. This may be partly true; but neither the wisdom nor the legality of the milling-in-transit system is wholly above question. We fear that the New York Commission has been misled by the analogies of passenger rates, coupled with the innate fondness of all government authorities for a *pro rata* system of charges. With regard to the analogy of passenger rates, it need only be said that the railroads arrange passenger tariffs on an equal mileage basis because they cannot help themselves. They have enough quarrels about stop over privileges under the very best of circumstances; if the stop-over privilege becomes a thing of much commercial value, and not a mere convenience to the individual, these quarrels are enormously increased, and make more trouble than the whole matter is worth. As far as railroad economy is concerned, it would be better not to make passenger charges proportionate to the distance; but the scalpers could practically reduce the intermediate charges at all important points to the pro rata basis, whatever the nominal tariff. In freight it is different. There the railroad has the advantage of the shipper. A bushel of corn cannot get out of a car and change places with a bushel of wheat. An ox cannot go to a scalper and sell him the unused portion of his way bill, to be afterwards transferred to some other ox. The freight tariffs can thus be arranged on principles of good railroad economy. It does not become necessary to charge twice as much for 200 miles as it does for 100. The advantage to the public is obvious. Even the New York State Commission, while it urges the railroads "seriously to consider" a reduction of the Buffalo rates to the Chicago mileage rates, does not face the legitimate alternative of urging them to raise the Chicago mileage rate to the level of that of Buffalo. Yet if the principle were carried out, the latter result would be ten times more probable than the former.

Block Signaling in England.

An account of the best present English practice in block-signal working forms the subject of an article printed in another column. The writer, as he says, repeats some facts which are well known; but he is writing about important principles, and simplicity is a good fault. The history of block signaling and all the varieties of practice with it has never been fully and compactly written, and, moreover, history in this line is being made every day, so that a restatement of elementary truths is not without its uses.

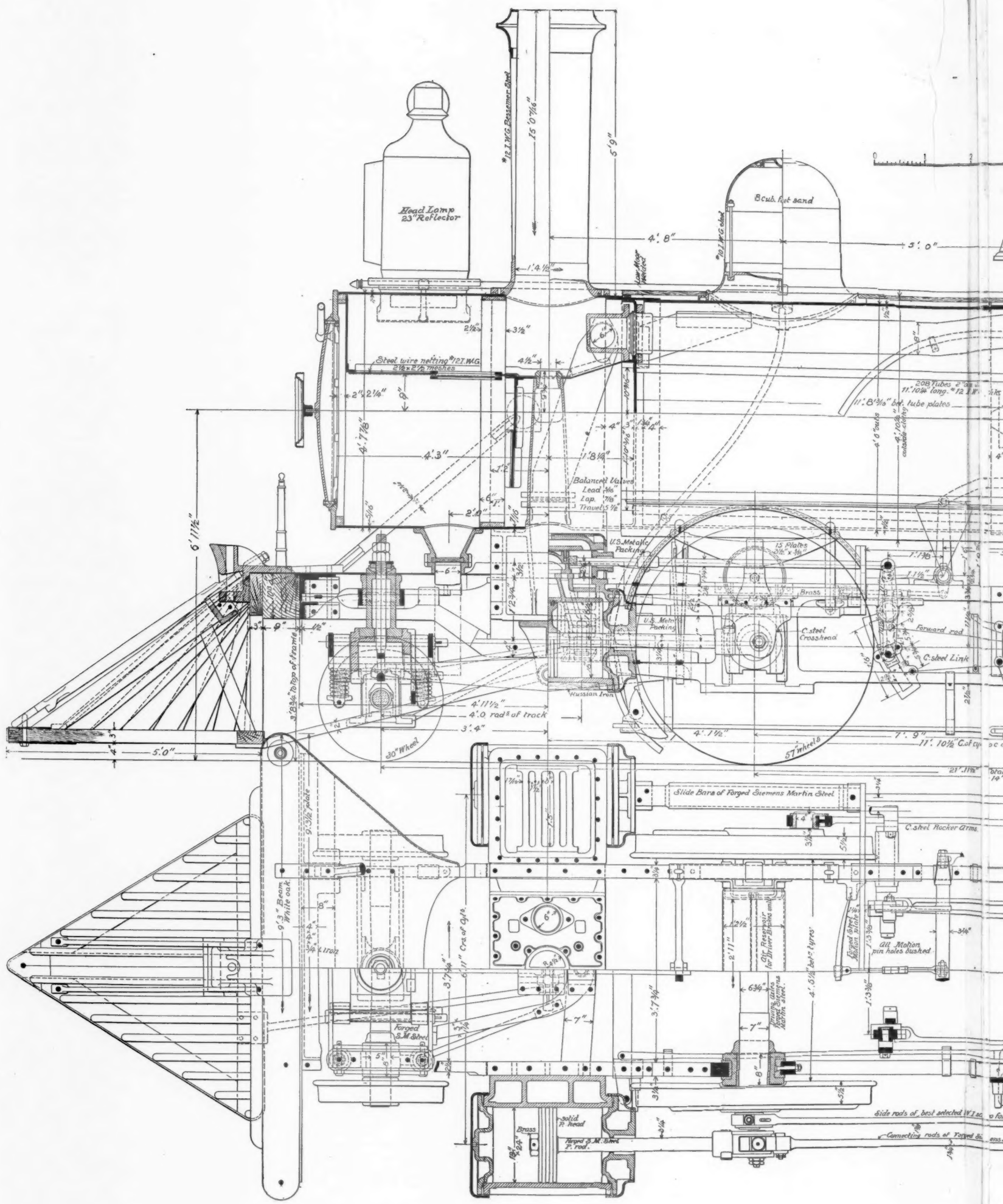
Mr. Farrer's stricture on our statement of March 15 involves no contradiction. We stated what were the inspectors' requirements, not what compliance the roads give to those requirements, though they are observed on well known lines, and sufficiently to give them a standing in practice as well as in theory.

In practice the distance between the home and the starting signal must often be considerable, and the advanced starting signal should be separated from the starting also by a long space. The first mentioned space should be calculated to hold a long train, and the other, to get the best results, should also be long. There is, therefore, weight in the objection raised by our correspondent to the placing of three signals, thus related to each other, under control of one signalman. The signal furthest from him must almost inevitably be a long distance off, and in dark nights or foggy days, when he cannot decide with precision at what moment a train has cleared a fouling point, he must either run some risk in admitting a following train or else delay it considerably while waiting to assure himself that the track is clear. The Board of Trade Inspector, in a late accident investigation, criticised an arrangement of this kind, where one signalman controlled what was virtually two block sections, though one of them was a very short one. One of the recognized safeguards of block working, to wit, that to produce a collision, two men must concurrently commit the same error, is by this practice done away with, and the value of the system that much weakened. It is



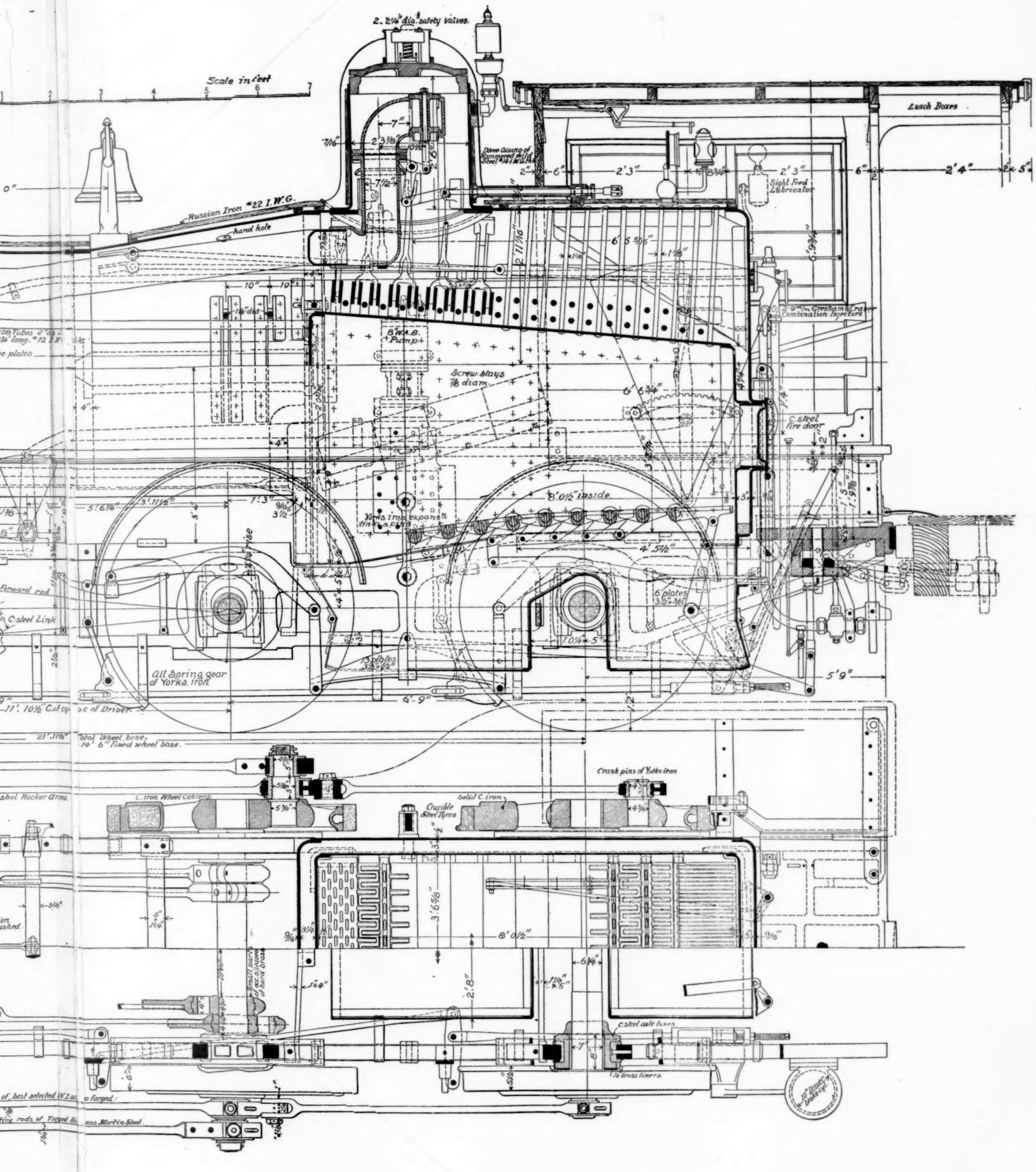
MOGUL LOCOMOTIVE, CANADIA

Designed by MR. F. R. F. BROWN, *Me*



MOGUL LOCOMOTIVE, CANADIAN

Designed by MR. F. R. F. BROWN, Mechan



VE, CANADIAN PACIFIC RAILWAY.

. F. BROWN, *Mechanical Superintendent.*

impossible, however, in a station yard where much switching is done to get the advantage of a remote signalman's oversight of operations without sacrificing considerable time.

"Working up to signals without any warning arrangement," means, we suppose, the use of home-signals without distant signals, though it is possible that Mr. Farrer, in his closing paragraph, refers simply to the increasing tendency to protect trains by only one positive signal (the home) instead of two (the home and starting), or by requiring trains to go but little or no distance beyond the home signal before they shall be deemed to have cleared it, instead of several hundred yards. We cannot fully agree with our correspondent that this change is to be regretted. The English lines were behind ours in adopting power brakes, and even now some of them run passenger trains with inadequate fittings or none at all (except the hand brakes on front and rear cars). Freight trains are still run with a large percentage of cars virtually unbraked so far as emergency stops are concerned. This sort of practice having been universal for many years it was only natural that signals should be reinforced wherever possible by caution, extra-caution and whatsoever other kinds of warning might be found possible. The less power possessed by an engineer to bring his train to a stop the earlier should he have the warning given him and the more complete should it be. Hence the general practice of treating the starting signal as the important stop signal, the home signal as a caution signal for that and the distant as a caution signal for the caution signal. But one of the cardinal points in signaling is the requirement that semaphores with square ends shall *never* be passed when in the horizontal position, and it would seem that this extensive provision for the contingency when this requirement will be disregarded would be likely to weaken the effect of the rule. Of course, the runners will know what instruction is given to the signalman, and they must be tempted to take advantage of it. If home signals, so called, are not to be used to hold a train except when the train is also protected by the starting signal why have the home signal at all? It is true that it would still be useful in switching, but to have a positive signal constantly before the eyes of the engineers, while at the same time teaching them by example to regard it as partaking somewhat of the nature of a caution signal seems radically wrong. The true office of the distant signal is to warn engineers to *stop* at the first positive signal they thereafter come to. To expect them to stop at some indefinite point between the first and second, or between the first and third, is about as bad as to require them, on the warning afforded by the distant signal alone, to stop at some indefinite point before reaching the home signal, which it seems is the practice on some English as well as American roads. The latter practice deprives the runner of the benefit of the distant signal as a landmark to guide him in applying brakes, and the former confuses the indications of the home signal. In either case the space in which the stop may be made is uncertain, whereas a cardinal principle of all fixed signals is or should be to indicate this space definitely.

To keep trains only the thickness of a signal post apart does not violate the essential requirement that a *space* shall be maintained between trains. The only question should be, is the space enough? If it is not, the remedy would seem to be more numerous or more efficient caution signals. To send an engineer forward under the advice "section clear, station blocked," is virtually to tell him "we do not trust you to obey the caution signal;" and this must tend to weaken his respect for that signal. If the station is cleared before he arrives he has been warned unnecessarily.

Hints from Max O'Rell.

Max O'Rell, in his very amusing book about America, says that there are two kinds of truth, the truth that is true, and the truth that might be true, and obviously he does not care which kind he tells. In fact a third kind, that which he thinks might, under favorable conditions, be true, suits him as well as any other. In his chapter on American railroads he tells all three kinds of truth. When he tells us, for instance, that the sleeping car porters sometimes make from $2,500 to $3,000 a year in fees, besides their regular pay, we must class the yarn in the third kind of truth; but he tells a good deal of truth that is true about some of the flagrant but preventable annoyances to which Americans who travel by rail submit with patience and good humor which surprise him. He found the vestibule trains marvels of comfort and luxury, but says that "the car conductors are generally impolite, and even rude," and the patience with which the Americans bear the torments of the train peddler he thinks angelic. Max O'Rell appears not to have lost his temper because of these annoyances, but he accepted them with the spirit of a humorous philosopher. Making allowance for some over-statement, his impressions of the train boy may be taken to represent those of any average, reasonable man who has not become inured to his impositions by long-suffering.

For his estimate of the conductor much allowance must be made. Obsequiousness must not be expected of a citizen of the Republic who owns a trotting horse and a Queen Anne villa. The American train conductor is not a man to be browbeaten and tipped. He is a possible general manager, doing his duty in his present sphere with no superfluous words, with very plain manners, with perfect self-respect, and with no suspicion that there is any hard and fast line between his social position and that of Mr. Max O'Rell. He and his passenger are two respectable business men, meeting for a moment in a business way, and their affairs together are to be transacted with the minimum expenditure of time and breath. It is this aspect of the American character that is most difficult, and indeed almost impossible for any foreigner to comprehend. Theoretically he may be an ardent believer in a pure democracy; practically he must miss the deference to which he has all his life been used from those in positions inferior to his own. In England the guards and trainmen are classed as "railway servants;" in the United States "servant" is a term sparingly applied to any class and never to railroad employés. It is true that occasionally a train conductor is met who is "impolite and even rude," but generally speaking they are courteous and civil as an American understands courtesy and civility. Their manners may not be Max O'Rell's manners but most of us think them fairly good manners. Of the brakemen much the same may be said. One often wishes that they would not slam the doors quite so hard, that they would not spit on the car floor, that they were a little more sensitive to bad ventilation and not quite so enthusiastic in firing up. As the demands of the traveling public grow more exacting in these and other particulars the trainmen improve; and when Max O'Rell next visits America, he will, we hope, find the trains quieter and better ventilated, and the conductors and brakemen willing to take a little more time and to enunciate more distinctly in answering his questions.

For the train boy little that is good can be said. He is an almost unqualified nuisance, and one cannot help sharing Max O'Rell's surprise that he should be tolerated. It is sometimes a convenience to be able to get from him a newspaper or a magazine, but at what a cost of quiet and comfort that small convenience is purchased! Everything that he has to sell is poor in quality and dear in price. Even his newspapers are stale. His noisy passages through the train harass the nerves and make naps impossible. He flings dog-eared books and dirty packages of confectionary into your lap with imperturbable impudence, and grins at your protests. He can easily spoil all the comfort of a journey for a nervous or fussy person. Attempts to regulate him are made, but are almost always failures. He may be instructed that he is not to slam doors, that he is not to shout in the cars, that he is not to throw things in the seats or the laps of passengers. But he cannot be regulated. He will bribe a brakeman with a cigar or a stick of gum, and ply his vocation in his own fashion, unchecked. The only thing to do with him is to get rid of him. This, fortunately, some of the roads are disposed to do, and there can be no great difficulty in doing it. Certainly it requires no extraordinary foresight for a man to provide himself with cigars and reading matter before starting on a journey. If one has not that foresight he, and not his fellow travelers, should suffer for his mental defects. The multiplication of news-stands, buffets and buffet cars on the lines of greatest travel is preparing the way to eliminate the train boy, but he will probably be with us for some years to come. Meantime he can be somewhat mitigated.

Alloys of Metals.

Much attention is now being paid to alloys of metals, not only to the proper components and to their proportions, but also to their manipulation. Alloys having the same components vary in character for the same reason that two makes of steel, having equal amounts of carbon, differ in their characteristics and value as a structural material. This difference is much dependent upon the method of manufacture. Various results are got even when the constituents are of the same kind and the same quantity. Of all the desirable and valuable characteristics of a cast alloy the three most difficult to obtain are great density, uniform density, and uniform composition throughout the mass. A dense casting may contain large cast holes and irregular places, and not be uniformly dense. A uniformly dense casting may be full of minute interstices, and therefore not of great density. A common fault with extremely and uniformly dense castings is a lack of uniformity of composition. This may be seen by a mere inspection in a clear light, which shows the variation of color on different parts of the surface. The result of a lack of uniformity of composition is a correspondingly great variation in the wearing qualities and strength of the casting. Almost always variations in the composition, where equal amounts of the various constituents have been put in the furnace, is caused by lack of attention to mixing the metal in the pots or crucibles. However, if the temperature be raised too high after the introduction of the more volatile constituents, or if the various components be added in a wrong order or at the wrong time during the melting process, the result will be a lack of uniformity in casting from different melting in which have been used the same constituents in the same amount. In order to obtain a satisfactory degree of density in cast steel the ingots have been subjected to a heavy pressure while in the molten state. The increase in density thus obtained adds considerably to the tensile strength and increases its resistance to abrasion. Lack of uniformity in density of castings is to a large extent caused by the method of pouring and the character of the mold. Those who are accustomed to seeing samples of alloys dissolved in acid will remember that often large pieces of the unmixed components are found to exist in spots throughout the alloy, or rather mixture, which is what such compositions should be called. Alloys are, strictly speaking, uniform mechanical mixtures of metal, and are by some considered to be chemical combinations of metals, because the characteristics of the alloy do not vary exactly with the variations in the respective amounts of the components, and are but in a small way indicated by the character of the metals which compose it. That is, hard metal will sometimes make soft alloys, and metals of a melting compound will often combine to make an alloy which melts at a temperature lower than either of the constituents.

Thus it can be seen that there is much reason for the study of the proper mixture of alloys, with regard not only to the respective amounts of the components, but with regard to the mechanical manipulation of the process and the removal of all gases, which reduce the density of the ingot. At no period in the history of mechanical arts has so much thought and labor been devoted to the production of alloys of various metals on a large scale as at the present time. Even the chilled wheel makers are looking for a tougher and more satisfactory alloy for making chilled wheels, and a large number of the superior bearing bronzes in the field show the value of proper manipulation during the production of alloys. Such bronzes are not the result so much of the selection of the components as the perfection of the method of manufacture. The processes are, as a rule, kept as manufacturers' secrets. In another column is a letter from a correspondent who has had considerable experience in alloys suitable for bearings, which will convey some idea of the care in detail necessary to produce a good bearing metal.

April Accidents.

Our record of train accidents in April, given in this number, includes 36 collisions, 52 derailments and 5 other accidents; a total of 93 accidents, in which 45 persons were killed and 86 injured.

These accidents are classified as follows:

COLLISIONS:		
Rear	19	
Butting	16	
Crossing and miscellaneous	1	
		—36
DERAILMENTS:		
Broken rail	3	
Loose or spread rail	1	
Broken bridge or trestle	6	
Defective switch	1	
Broken wheel	3	
Broken axle	2	
Broken draw bar	1	
Fall of brake beam	1	
Misplaced switch	5	
Careless running	1	
Cattle on track	3	
Washout	2	
Landslide	2	
Malicious obstruction	1	
Switch purposely misplaced	1	
Hand-car	1	
Fire	1	
Cave in of mine	1	
Unexplained	16	
		— 52
OTHER ACCIDENTS:		
Boiler explosions	3	
Miscellaneous	2	
		— 5
Total number of accidents		93

The causes of collisions where given were as follows:

	Rear.	But-ting.	Crossing and other.	Total.
Trains breaking in two	5	..	..	5
Misplaced switch	1	3	..	5
Failure to give or observe signal.	..	2	..	2
Mistake in giving or understanding orders	..	2	..	2
Miscellaneous	10	3	..	13
Unexplained	3	6	1	10
Total	19	16	1	36

A general classification shows:

	Collisions.	Derailments.	Other Accd'ts.	Total.	P. c.
Defects of road	..	11	..	11	12
Defects of equipment	5	7	4	16	18
Negligence in operating	21	6	..	27	29
Unforeseen obstructions	..	12	1	13	14
Unexplained	10	16	..	26	27
Total	36	52	5	93	100

The number of trains involved is as follows:

	Collisions.	Derailments.	Other.	Total.	P.c.
Passenger	24	16	3	43	36
Freight and other.	38	36	2	76	64
Total	62	52	5	119	100

The casualties may be divided as follows:

KILLED.	Collisions.	Derailments.	Other acc'ds.	Total.	P. c.
Employés	12	10	..	22	49
Passengers	8	2	..	10	24
Others	9	4	..	13	27
Total	29	16	..	45	100
INJURED.					
Employés	20	39	1	60	69
Passengers	11	10	..	21	24
Others	5	..	..	5	7
Total	36	49	1	86	100

The casualties to pa-sengers and employés, when divided according to the classes of causes, appear as follows:

	Pass. killed.	Pass. injured.	Emp. killed.	Emp. injured.
Defec s of road	1	9	4	15
Defects of equipment	1	1	1	6
Negligence in operating	8	11	12	23
Unforescen obstructions and maliciousness	..	..	5	9
Unexplained	..	..	..	7
Total	10	21	22	60

Twenty-three accidents caused the death of one or more persons, and 28 caused injury but not death, leaving 42 (45 per cent. of the whole) which caused no personal injury worthy of record.

The comparison with April, 1888 and 1887, shows:

	1889.	1888.	1887.
Rear collisions	19	23	11
Butting "	16	20	17
Crossing and other collisions	1	6	..
Derailments	52	83	58
Other accidents	5	4	4
Total "	93	136	90
Employés killed	22	33	36
Others "	23	9	5
Employés injured	60	107	74
Others "	26	84	34
Passenger trains involved	43	46	26
Average per day:			
Accidents	3.10	4.53	3.00
Killed	1.50	1.40	1.37
Injured	2.77	6.20	3.60
Average per accident:			
Killed	0.483	0.308	0.455
Injured	0.924	1.368	1.200

The worst accident of the month was that at Lorenzo, Ill., on the 10th, which we have discussed heretofore. There were, however, an unusual number of others which killed two, three or more persons each. The tramps fared particularly hard this month, a dozen of them having been killed in a half dozen accidents. In nearly every one of these cases the cause was negligence in operating, but we presume that the fatality did not have much to do with the censure visited upon the trainmen. One collision, in which the detached portion of a freight ascending a grade ran back into another train, resulted in the injury of six of these objectionable passengers, and it might be surmised by one who knows the views of freight trainmen regarding them, that possibly the getting rid of these deadheads had something to do with the purposes of the trainmen! The number of employés killed has been very uniform for the past three months, but the number of passengers killed in April shows a sharp increase, there having been none reported for March, and only one (a drover in a stock train) in February. The collision at St. Paul on the 2d was one of the most deplorable of the month. An old yardmaster, who had charge of the train, stood on the front platform motioning the engineer forward with his lantern. A number of the occupants of the car were trainmen acquainted with the locality, and one of them remonstrated with the yardmaster and repeated his caution, but it seems that it had the effect of confirming the latter in his self-confidence rather than otherwise. Strict conformity to regulations, even where it may seem wasteful of time and labor, or even wholly unnecessary, seems to be the only safeguard against serious personal injury and death in a considerable percentage of instances, and this is apparently the chief lesson of this collision. Neglect of the simple rule to never carry passengers, even "deadheads," except in a properly made up train which is duly announced by special time table or dispatcher's order may probably be held resposible for these fatalities. And yet it is the occurrence of accidents like this, where every victim has had to be paid a large damage bill—though in this instance the damage bills may be small—that has brought into use the rule above referred to. If this, or any other rule which it is hard to enforce, is a good one immediately after a fatal accident, why is it not equally good at other times?

The merits of wood pavement as a roadway for light locomotives were tested at Dallas, Tex., last month, where a runaway engine, which had been deserted by its runner when a butting collision was impending, ran off the end of the track after having traveled several miles, and not only crossed the street but ran some distance up a cross street and entered a saloon. It appears that the hard character of the saloon, or of the curbing in front of it, put a stop to the wild flight of the engine. The collision on the Atchison, Topeka & Santa Fe, where a freight ran into the rear of a passenger train, occurred in the Raton Tunnel, and the passengers who were imprisoned in the tunnel for an hour and a half suffered considerably from the gas emitted by the three engines. The passenger train was moving at the time of the collision, and it does not appear how the freight came to overtake it. The Mexican National had a bad collision, April 4, in which an engineer was killed.

The New York state law concerning highway grade crossings was amended by the Legislature at its last session, so that its provisions are now substantially as follows: The Supreme or a county court may upon application of the local authorities and upon ten days' notice to the railroad, order flagmen or gates, and direct that "a person be stationed to open and close such gates when an engine or train passes, or make such other order as it deems proper." The local authorities must first have unsuccessfully applied to the railroad company. Whenever a crossing in a city or village shall be protected by gates, "with persons stationed to open and close the same when an engine or train passes," the village or city, if its population be less than 50,000, cannot limit the speed of trains to less than 30 miles an hour. It appears that this law was passed at the instance of the New York Central for the purpose of relieving that road from the onerous restrictions imposed by some of the towns along its line; and the speed of some of the trains through Amsterdam was suddenly increased last week, to the surprise of the city officials. They had not heard of the change in the law, and got out a warrant for the arrest of an engineer. Many of the existing restrictions upon the speed of trains within the limits of towns and villages are relics of the past, and should be materially modified if not abolished. To require a very low speed throughout the entire length of a village, when the object aimed at is simply the restriction of the speed at a few important crossings, is a crude and unnecessary arrangement; and to require a slow rate at well protected crossings simply because trains have run slowly in that locality in years past, when the protection was poor, is equally unreasonable. A road through a thickly settled country, like that traversed by the New York Central or the Pennsylvania, must sooner or later encounter a state of things which will become intolerable unless these restrictions upon the speed of trains are modified to conform to modern conditions. The public demands fast trains, but it is right that the safety of the people at crossings should at the same time be carefully looked after. No one denies that there is still room for very much improvement in the protection of crossings. The point which most needs to be watched by the railroads working under the New York law, is that concerning the provision for an attendant at gates, which apparently contemplates no intermission in the service. Although the language of the law appears not to have been drawn with special reference to this point, it seems quite clear that such a thing as leaving a gate at night without an attendant was not thought of. And yet this is just where a big loophole is left open in many cases. A road which increases the speed of any of its trains at a crossing which is not attended during the whole of every 24 hours may find the change more costly than would at first appear. If a person is struck by a train, even if the train be running slowly, he will, if he have good evidence that there was no man in attendance, find it much easier to convince a jury that the road was at fault in some respect than he would under former regulations.

The case of the soldier who gets a pension for being hurt while playing ball "in the line of duty," is matched by that of a railroad laborer mentioned in our Railroad Law column this week. This unfortunate man was "watching" the steam shovel, doubtless cogitating the while on its inability to vote, even though it had usurped the Irishman's other prerogative, and for this laudable purpose he took up his position on the main track in front of an express train. The Missouri Supreme Court holds the company for damages. A Maryland road was more fortunate, the Court of Appeals of that state justly rebuking the "cheek" of a claimant who was struck by a train which was directly before his eyes for 1,000 feet before it reached him. The man was walking on the track by no right except custom. Another decision seems to have fixed upon six seconds as the minimum time in which a scared driver ought to recover his senses and "hustle" off the track when a train approaches the crossing which he is traveling over.

NEW PUBLICATIONS.

A Treatise on Hydraulics and Pneumatics. For Use in Technical Schools. By Irving P. Church, C. E. New York: John Wiley & Sons. 1889. 8vo, pp. xiii., 317.

This work follows, in general, the plan of previous writers who have adopted the analytic treatment for problems in the mechanics of fluids; but there are many praiseworthy deviations from the beaten path, consisting in the introduction of recent data on discharge over weirs, friction in pipes and bends, the flow in rivers, etc. The result is a text-book considerably above the average; perhaps as good a text-book as will be written until our professors decide to break down the wall of demarcation now existing between *theoretical* and *practical* or *actual* results, and reach the conclusion, which is of necessity adopted by engineers in their practice, that a correct theoretical formula or rule is one which includes all the practical data; since true theory and practice are always in accord. It is difficult, for example, to see what benefit a student will derive from mastering the three theories (pages 773 to 780) on the efflux of air, to find that they give, respectively, in numerical example, weights of flow equaling 0.82, 0.722 and 0.756 pounds per second; since this so-called theoretical discussion is immediately followed by "Practical Notes," in which the results of experiments are discussed. But old abuses are hard to uproot, and most writers would think that they were diverging dangerously from the conventional did they reject all theory which was not confirmed by practice.

In several instances where practical discussions are given, the author does not seem to have exercised sufficient care in selecting his data. For instance, in considering the resistance of tubes to collapse, he gives a formula, as Fairbairn's, which allows considerable more pressure than does the actual formula established by Sir William Fairbairn, and which has been shown by practical experiment to be very unreliable. Again, it need hardly be said that a discussion of the economy obtained by expanding steam, omitting all consideration of clearance, wire drawing, condensation and radiation, is worse than useless; and that the example of a steam engine operated with a cut-off at one-quarter stroke and without expansion, wherein it is shown that the engine consumes four times as much steam in the latter case as in the former, is thoroughly misleading. It is probable that students in an institution where a work of this character is used as a text book will receive more correct ideas ideas concerning the behavior of steam in the cylinder of an engine, so that a *theoretical* discussion of this character might well be omitted. The same remark will apply to the discussion of the adiabatic expansion of air, where formulas giving rough approximations are substituted for the correct values established by writers on thermodynamics.

There are several other apparent defects of the same general character; but the work, on the whole, gives evidence of deep research and conscientious treatment.

A History of the Planing Mill, by C. R. Tompkins, M. E. New York: John Wiley & Sons. 1889. 12 mo, pp. IX., 222.

The history of the invention and development of the planing mill is one of great interest, and is well related by the author in this little work. William Woodworth who may be said to have produced the first complete planing-machine, patented Dec. 27, 1828, reissued in 1845, and twice extended, so that the patent was in force 28 years, like many other inventors of successful devices, did not realize a great pecuniary reward. He sold his patent to three capitalists for about five thousand dollars, and the buyers realized immense fortunes from this purchase. Their mode of operation is an interesting illustration of the monopoly which can be caused by a patent so broadly construed as to shut out all competitors. All planing mills were sold under license, two at most being allowed in any town; the royalty charged being $3 for each 1,000 ft. of lumber plained and matched, the licensee being required to charge customers $7 per thousand.

Some relief from this monopoly was obtained by the invention of the Norcross planing-machine, which did not infringe the Woodworth patents, according to a judicial decision. The Norcross machine was inferior to the Woodworth planer, but was largely used nevertheless. On the expiration of the Woodworth patent the planing-machine was greatly improved by many inventors; and the author gives an interesting comparison, showing the development from a machine with cutters, having a speed of 1,200 revolutions a minute, and planing 4 ft. a minute, to the modern mill, with cutters revolving at from 3,000 to 4,000 revolutions and finishing from 40 to 50 ft. of lumber per minute.

Besides the historical account of the planing mill, the author, who has had an extensive practical experience in the construction, erection and management of wood-working machinery, furnishes many valuable hints as to details of construction, management, proportioning pulleys and belts, the proper care of belting and other useful points. The practical remarks have a literary merit of their own, being written in plain and interesting language which render them very useful.

This book, while it will perhaps be perfectly intelligible to practical wood-workers, will be somewhat obscure in many places to persons who are unfamiliar with planing machines, because there are no sketches, either of complete machines or of the various details described. It might have been better, also, if the author had supplemented the statement that "at the present day manufacturers know or should know just what power is required to run each machine that they furnish," with some reliable data on this point.

Report of the Fourth Annual Meeting of the Illinois Society of Engineers and Surveyors. Price, 50 cents. To be had of Prof. A. N. Talbot, Executive Secretary, Champagn, Ill.

The meeting of which this is a report was held at Bloomington, Ill., Jan. 23, 24 and 25, 1889. Embodied in the report are a number of interesting papers on a variety of topics, and topical discussions of many questions. Among the papers of special interest to railroad men are: "Railroad Accidents, Their Causes and Prevention," by S. F. Balcom, Assistant Engineer, Illinois Central Railroad; "Progress of Work on the Cairo Bridge," by the same author; "The Nichols Hollow Culvert," by E. A. Hill, Cincinnati, Indianapolis, St. Louis & Chicago Railway, Cincinnati, O., and "Measuring and Computing Earthwork," by E. L. Morse.

TRADE CATALOGUES.

Catalogue of the Berlin Iron Bridge Co., East Berlin, Conn.—This catalogue contains illustrations and brief descriptions of many bridges built by this company, with its well-known parabolic truss. The illustrations are all from

photographs of structures in place. There are shown also several examples of plate girder bridges and of iron buildings and roofs. Among the plate girder bridges shown is one of those of the New York, New Haven & Hartford, and the New York & New England, over Asylum street, at Hartford. These bridges are both double track, plate-girder structures, with iron and concrete floors. Each girder weighed 40 tons, said to be the heaviest single plate girder ever built in this country. Another interesting structure is the coal storehouse of the Burlington Water-works at Burlington, Vt. This is a building 40 by 98 ft. The iron roof is so constructed that a coal car can pass from the dock by means of a trestle the whole length of the building above the level of the top of the walls. The roof and trusses carry stringers, upon which is laid a railroad track. The train sheds of the New York, New Haven & Hartford, built at New Haven in 1885, are also illustrated. The building is 120 ft. wide by 400 ft. long, the roof being in two spans of 65 ft. each. The whole structure is of glass and iron, no wood whatever having been used.

Train Accidents in April.

COLLISIONS.

REAR.

2d, on New York, Pennsylvania & Ohio, near Cortlandt, O., freight train separated in two places and the detached sections collided, throwing several cars over an embankment.

2d, on New York & New England, near West Pawling, N. Y., freight train ran into the rear of a work train, injuring an employé. The freight was properly flagged, but its speed was too high.

2d, night, on Chicago, St. Louis & Pittsburgh, near Centreville, Ind., a freight train of 26 cars ascending a heavy grade broke in two at the fourth car from the engine; the rear portion ran back down grade into a following train, damaging the engine and wrecking 8 cars and a caboose. Three tramps killed and three injured.

2d, 11 p. m., on Chicago, St. Paul, Minneapolis & Omaha, in the Western Division yard in St. Paul, Minn., a special passenger train consisting of one car pushed by an engine ran into some freight cars standing on the main track. Three passengers and 1 tresspasser killed, and 3 passengers and 1 tresspasser injured. The passengers were employés in the company's shops, who were returning home after attending a meeting at the St. Paul Union Depot. The brakeman of the switching freight, which had the cars on the main track, states that he signaled the passenger train to stop. The men in charge of the latter had considerable discussion and some doubts about the safety of proceeding through the yard at the speed they were running, but the man who was in charge of the train was killed.

2d, on Indianapolis & St. Louis, at Charleston, Ill., freight train ran into a preceding freight, doing some damage, killing a number of horses.

3d, on Baltimore & Ohio, near Rockville, Md., a passenger train, the engine of which had been disabled by a broken piston-rod, while standing at the foot of a grade on a curve, was run into by a following freight train before it could be flagged and controlled, smashing the rear sleeping car, damaging the freight engine and derailing several cars. Engineer of freight injured by jumping. All passengers escaped uninjured from the demolished car. The force of the collision was tempered by the passenger runner getting his train in motion before it was struck.

4th, on New York, Lake Erie & Western, at Warsaw, N. Y., a freight train broke in two and the rear portion ran into the forward one, wrecking several cars.

6th, on New York, Lake Erie & Western, at Forest City, Pa., a Delaware & Hudson accommodation train standing at the station was run into by an Erie freight train, damaging the engine and rear coach. One trainman and one passenger injured.

7th, night, on Atchison, Topeka & Santa Fe, in a tunnel near Morley, N. M., a passenger train was run into by a closely-following freight train, damaging the rear Pullman sleeper.

8th, on Wisconsin Central, in Chicago, Ill., passenger train ran over a misplaced switch and into some freight cars standing on a side-track. Front of locomotive and a box-car damaged.

10th, 4 a. m., on Chicago, Santa Fe & California, at Lorenzo, Ill., freight train ran into the rear of a passenger train, crushing the rear car, killing 5 passengers and injuring 3 trainmen. The freight had been running too fast and encroached on the passenger train's time.

15th, on New Orleans & Northeastern, at Meridian, Miss., passenger train collided with two box-cars left on the main track by mistake, doing considerable damage. Fireman injured by jumping.

16th, on Pennsylvania, near Red Bank, N. J., a car of the Adams Express Co. at the rear end of a freight train became detached and, in recoupling, collided with it The contents of the car caught fire from an overturned stove and an express messenger in extinguishing the flames was severely burned about the face.

18th, on New York, Lake Erie & Western, at Big Flats, N. Y., freight train broke in two and the rear section ran into the forward one, derailing several cars.

19th, 11 a. m., on Louisville & Nashville, near Glencoe, Ky., a passenger train stopped on account of a slight mishap to the engine. The flagman went out and placed torpedoes, but just as he returded and the passenger train had got in motion, a freight running at high speed dashed into the rear car, derailing and overturning the engine and one car. Five passengers and one trainman injured.

20th, on Louisville & Nashville, at Mallory's, Tenn., an engine became unmanageable, owing to disarranged throttle, and ran into some box cars, doing slight damage.

22d, on Boston & Albany, near Worcester, Mass., a freight train broke in two and the detached portion collided with the forward one, wrecking 6 cars. Oil in two tank cars was ignited by the shock and much of the wreck was burnt up.

26th, about 2 a. m., on Pennsylvania, near the Delaware River Bridge at Trenton, N. J., a freight train ran into the rear of a preceding freight on a curve in a dense fog, wrecking engine, caboose and 6 cars. A man in the caboose was killed.

26th, on Boston & Albany, at Springfield, Mass., a passenger train ran into the rear of a freight train, damaging engine and caboose and derailing 2 tank cars. The track was wet and the passenger engine, upon being reversed, blew out both cylinder heads.

BUTTING.

1st, on Pennsylvania, at Deacon's Swith, N. J., passenger train ran into the head of a freight backing on to a side track, damaging the locomotives and derailing the tender of passenger engine. One trainman injured. The passenger train was flagged, but, owing to fog and rain, the signal was not seen soon enough.

2d, about 8 p. m., on Northern Pacific, at Prickly Pear Junction, Mont., an east-bound passenger train ran over a misplaced switch and collided with a double-header freight train which had backed on to the side track, damaging 3 engines. Fireman and two tramps killed.

4th, on Louisville & Nashville, at Brown's Cross Road, Tenn., butting collision between freight train second 74 moving north and 71 moving south. Both trains were running at considerable speed and both engines and 16 cars were completely wrecked. Three trainmen killed. Train 71 left the previous station without examining the train register to make sure that both sections of 74 had arrived. The conductor inquired of the yardmaster and operator and was informed that 74 had arrived, but the persons giving this answer alluded to the first section.

4th, on Central Pacific, near Reno, Nev., butting collision between two freight trains on a sharp curve, wrecking both engines and 14 cars. Two trainmen killed.

6th, on Atchison, Topeka & Santa F, near Trinidad, Col., butting collision between two passenger trains, each drawn by two engines, which with several cars were wrecked. Engineer injured and a tramp killed.

7th, on Atlantic & Pacific, near Peach Springs, Ariz, butting collision between two passenger trains on a curve, in which the engines, mail and baggage cars were thrown over an embankment into a river and badly wrecked. One trainman injured and a tramp stealing a ride on the front end of the baggage car killed.

10th, on Colorado Midland, near Aspen Junction, Col., butting collision between a passenger train and an empty engine, damaging both engines and several coaches. Two passengers injured.

15th, on Delaware & Hudson Canal Co.'s road, at Putnam, N. Y., butting collision between a north-bound mixed train and a south-bound freight which had pulled by the station with the intention of backing on to the side track. Engineer of mixed train killed, and one freight car derailed and overturned into Lake Champlain. The south-bound train had not sent its flagman sufficiently far ahead.

19th, on New York Central & Hudson River, near Lockport, N. Y., butting collision between two freight trains, one of which was going on to a side track and had not cleared the main track.

22d, on Atchison, Topeka & Santa Fé, at Alfred, I. T., butting collision between two freight trains, doing considerable damage.

24th, on Cincinnati, New Orleans & Texas Pacific, near Glen Mary, Tenn., butting collision between two freight trains, wrecking both. Three trainmen killed, 2 injured. Glen Mary is a schedule meeting point, and the crew of the south-bound freight, finding that an express train which they should have met here was 50 minutes late, and having authority to run against it, forgot all about a freight train which they were also to have met, and collided with it.

24th, on Memphis & Charleston, at Carpenter's, Tenn., a passenger train ran over a misplaced switch and into the head of a freight train standing on a side-track, wrecking both engines. Engineer and fireman of passenger train killed.

26th, on Baltimore & Ohio, in Baltimore, Md., butting collision between two passenger trains, due to a defective switch, damaging the engines and baggage cars of each train. Four trainmen injured.

27th, on Houston & Texas Central, near Sherman, Tex., butting collision between a passenger train and a freight train, damaging both engines and several cars loaded with cattle, a number of which were killed. One trainmen injured. The passenger train had orders to meet two trains at the preceding station, but pulled out upon the arrival of one of them.

27th, on Lake Shore & Michigan Southern, at Rolling Prairie, Ind., butting collision between west-bound fast mail and east-bound Atlantic express, damaging both engines and several cars. A tramp was killed. The east-bound train stood on the main track just clear of the switch leading to the turnout. The engineer of the west-bound train mistakenly assumed that the switch was set to lead him into the side-track.

27th, on Colorado Midland, near Hagerman Tunnel, Col., butting collision between a passenger train and an empty engine, damaging both engines and several cars. Two firemen injured. The empty engine was running contrary to orders on the passenger train's time.

CROSSING AND MISCELLANEOUS.

18th, on Southern Pacific, at Florence, Cal., passenger train just leaving the station ran into the of a construction train crossing the main track. Engine and half a dozen flat cars damaged.

DERAILMENTS.

DEFECTS OF ROAD.

1st, on Union Pacific, near Omaha, Neb., engine and 5 cars of a freight train thrown from the track by a broken rail and damaged. One trainman killed, 2 injured.

2d, on Baltimore & Ohio, near Belton, W. Va., a freight train ran on to a burning bridge and, the structure giving way, went down into the creek, where the wreck was fired by the burning timbers and consumed. Three trainmen injured by jumping. Two tramps killed.

8th, on Atlantic & Pacific, near Lavie Station, Cal., freight train ran into a creek, the bridge over which had been burned out during the previous night. One trainman killed and several injured.

8th, on Baltimore & Ohio, near 100th street, Chicago, the seventh car from the engine in a passenger train of 10 cars was derailed by a defective switch and the 4 rear cars crashed into some oil tank cars standing on a side track. One passenger killed and 9 injured. The bolt fastening the switch to the switch-rod was missing.

8th, on Missouri Pacific, near Atoka, I. T., engine of a freight train broke through a small trestle and with several cars was wrecked Brakeman injured.

21st, on Buffalo, Rochester & Pittsburgh, near West Seneca, N. Y., engine and 11 cars of a freight train thrown from the track by a broken rail.

24th, on Florida Railway & Navigation Co.'s road, near Belleview, Fla., freight train thrown from the track by a broken rail, wrecking 4 cars.

25th, on Pennsylvania, near Riverside, Pa., a freight train broke through a bridge which had been partially burned, presumably by a fire started under it by careless fishermen, but which a heavy rainstorm had extinguished. The engine and 8 cars, including a tank car containing oil, went down into the creek, took fire and were burned up. Engineer and fireman injured.

27th, on Southern Pacific, at Houston, Tex., an iron bridge resting on wooden abutments fell bodily (without breaking) under a freight train, all but the caboose going down into the stream 30 ft. below. One trainman killed 4 injured.

30th, on Chicago, St. Paul, Minneapolis & Omaha, near West Superior, Wis., engine and 12 cars of a construction train were derailed at a point where a rail was badly out of line. Fireman killed.

30th, on Texas & Pacific, near Cisco, Tex., freight train broke through a trestle, wrecking 7 cars.

DEFECTS OF EQUIPMENT.

3d, on Pittsburgh, Fort Wayne & Chicago, near Forest, O., 16 cars of a freight train were derailed and ditched, presumably by the dropping of a brake beam.

7th, on West Shore, at Byron Centre, N. Y., several cars of a freight train derailed by the breaking of an axle.

13th, on Southern Pacific, near Strauss, N. M., engine and 12 cars of a freight train were derailed by the breaking of a driving-wheel flange, going over an embankment. Engineer and fireman injured.

15th, on Fitchburg road, at Lake Pleasant, Mass., a drawbar in a freight train was pulled out and 7 cars were derailed and damaged.

15th, on Buffalo, Rochester & Pittsburgh, at Mumford, N. Y., coal train derailed by the breaking of an axle.

18th, on New York, New Haven & Hartford, at Turnerville, Conn, the New York & New England express, westbound, was derailed by a broken wheel under the smoking car, while the train was running at a considerable speed The train ran some distance off the sleepers until it reached the switch leading to the Colchester Branch, where the three rear cars took the branch. The smoking car was overturned just before it stopped. Although there were about 20 passengers in it, none were injured.

20th, on Central Iowa, near Berwick, Ill., a combination car and a coach of a mixed train were derailed at a bridge by a broken wheel and thrown into a creek. The wreck took fire from an overturned stove and, with a portion of the bridge, was consumed. Conductor and 1 passenger killed, 3 trainmen and 1 passenger injured.

NEGLIGENCE IN OPERATING.

7th, on San Francisco & North Pacific, at Tiburon, Cal. passenger train derailed by a misplaced switch.

14th, on Central Pacific, near Redding, Cal., passenger train derailed by a misplaced switch.

16th, on New York & New England, at Waterbury, Conn., engine and several cars of an accommodation train derailed by a misplaced switch.

17th, 8 p. m., on Pittsburgh & Lake Erie, at Coraopolis, Pa., passenger train derailed at an unfastened switch. Fireman injured. A freight train had just entered the side-track, and the brakeman in adjusting the switch left the lever unfastened.

19th, night, on Duluth & Iron Range, near Two Harbors, Minn, a freight train descending a steep grade became uncontrollable and ran at a high speed for 4 miles, when it was derailed, more than half the train being wrecked. Engineer injured. The train was equipped with the Westinghouse automatic brake, but the apparatus was either imperfectly adjusted or poorly managed, or both.

28th, on New York Central & Hudson River, at Cayuga, N. Y., passenger train of 6 cars derailed at a switch which was not properly fastened.

UNFORESEEN OBSTRUCTIONS.

5th, on Savannah, Florida & Western, near Savannah, Ga., freight train derailed by collision with a hand car. A number of cars were wrecked and conductor and engineer killed.

6th, on East Tennessee, Virginia & Georgia, near Brunswick, Ga., freight train derailed by a cow, wrecking engine and 8 cars. The wreck caught fire and was destroyed.

7th, on Richmond & Danville, at Pocomoke, Va., a freight train ran into a washout, derailing engine, tender and several cars. Engineer injured.

14th, on St. Louis, Alton & Terre Haute, near Belleville, Ill., owing to the caving in of an old coal mine, the engine and 15 cars of a passing freight train suddenly sank 10 ft. into the earth and were badly wrecked. Three trainmen injured.

17th, on Chicago & West Michigan, near Grandville, Mich., passenger train derailed by a purposely misplaced switch, the locomotive being overturned and baggage and smoking cars badly damaged.

18th, on Denver & Rio Grande, near Montrose, Col., engine of passenger train was struck by a landslide and thrown down a 30 ft. embankment into a river. Fireman killed. engineer injured.

20th, on Lehigh Valley, near Pittston, Pa., the rear car of a passenger train was derailed by a cow. The hind truck was torn off from the body of the car, and the latter dropped upon the rails. One passenger injured.

21st, on Milwaukee, Lake Shore & Western, near Marion, Wis., freight train derailed at a point where forest fires had destroyed the ties. Eight cars, including several loaded with hogs, were consumed. Engineer hurt by jumping.

25th, on Little Rock & Memphis, near Hazen, Ark., freight train ran over a herd of cattle, derailing the engine.

26th, on Richmond & Danville, near West Point, Va., freight train derailed at a washout, killing engineer and fireman.

27th, on Colorado Midland, near Hagerman Tunnel, Col., the rear car of a passenger train was derailed by a large stone which had rolled down the bank at one side of the track. The car ran some distance on the sleepers and was finally overturned; it was the pay car, and one man in it was injured.

28th, on Central of Georgia, near Jonesboro, Ga., engine of a passenger train was derailed by a tie which had been maliciously placed across the track, injuring the engineer.

UNEXPLAINED.

1st, on Pennsylvania, at Lewiston, N. J., 3 cars of a freight train were derailed.

2d, on Pennsylvania, at Jerry Run, Pa., 3 cars of a freight train loaded with logs were derailed. Two tramps stealing a ride were struck by flying timber and killed.

4th, on Burlington & Missouri River, near Lincoln, Neb., several cars of a freight train derailed. The engineer and fireman got frightened and leaped from the engine, which broke away from the cars and ran some distance, when it collided with a passenger train. Both engines wrecked.

5th, on Missouri Pacific, near Denton, Tex., two cars of a freight train derailed.

6th, on Brunswick & Western, near Lulaton, Ga., construction train derailed and wrecked, injuring 2 trainmen.

6th, on New York, Pennsylvania & Ohio, near Austintown, O, construction train derailed, ditching the caboose. Conductor and one employé injured.

12th, on Georgia Pacific, near Bremen, Ga., freight train derailed.

18th, on Louisville & Nashville, near Decatur, Ala., car of a freight train derailed on a bridge.

18th, on Geneva, Ithaca & Sayre, near Ithaca, N. Y., passenger train derailed.

20th, on Maine Central, near Skowhegan, Me., engine of passenger derailed on a curve.

21st, on New York & Brooklyn Bridge, at the New York end, switch engine running backwards derailed at a sharp curve.

22d, on Northern Pacific, at Thompson Falls, Mont., engine and 20 cars of a freight train were derailed and wrecked. Two trainmen injured. A temporary track was built around the wreck.

25th, on International & Great Northern, at Galveston, Tex., a switch engine was derailed on a trestle, tipped off and wrecked. Engineer injured.

25th, on Chesapeake & Ohio, near Big Sandy, W. Va., car of a freight train derailed on a trestle. Part of the trestle was demolished and 7 cars went down into the stream.

25th, on Oregon Railway & Navigation Co.'s road, at

Starbuck, W. T., smoking car of a passenger train was derailed and overturned, injuring 6 passengers.

30th, on Texas & Pacific, near Cisco, Tex., engine of passenger train detached from its train and returning from a wreck was derailed.

OTHER ACCIDENTS.

3d, on Prescott & Arizona Central, near Banghart's, Arizona, a loaded cattle car in a freight train caught fire from sparks from the locomotive and was destroyed.

14th, on Texas & Pacific, near Brazos, Tex., steam gauge of engine of passenger train blew out, badly scalding the engineer.

23d, on Baltimore & Ohio, at Utica, O., boiler of passenger engine exploded. Several adjacent buildings damaged.

24th, on Galveston, Harrisburg & San Antonio, near Columbus, Tex., engine of freight train exploded its boiler.

27th, on Atchison, Topeka & Santa Fé, at Emporia, Kan., a trunk in the baggage car of a passenger train standing at the station exploded, breaking all the windows and setting the car on fire.

A summary will be found in another column.

The Cost of Tracklaying.

Among the topical questions discussed at the last annual meeting of the Illinois Society of Engineers and Surveyors was that of the cost of track-laying. Mr. Charles Hansel, Engineer of the Wabash, usually calculates $350 per mile as the cost of laying, while the total cost, including ties and iron, is nearly $1 per foot. Mr. Morse said that on a branch of the Chicago, Burlington & Quincy the contract last year was $300 per mile. Mr. E. L. Contine said that on a Western Kansas road, on which he was Assistant Chief Engineer, the estimated cost for laying new work was $500 per mile, including train crews.

Prof. A N Talbot presented the following note: Mr. M. H. Munson, Track Engineer on the A., T. & S. F., some time ago kindly furnished me with a detailed statement of the distribution of force and the cost for laying track at the rate of two miles per day as practiced on that road. Ties were hauled by team, and the laying was done by the old style method. On the Larned Branch 15 miles in 7 days were laid with this force—under favorable circumstances, however, very light grades, light work, road-bed in first-class condition, and light earth for ballast. On the Arkansas City Extension the main track laid in a month cost $292 per mile. I am of the opinion that track laid and surfaced, under ordinary conditions, for less than $350 per mile is cheaply done. I may add that the track laying was not contract work; care was take to get first-class work, rails were not kinked by running over them before surfacing, and the surfacing gang left the track in excellent condition for new track.

The distribution and cost referred to is given in the table below:

Force for laying 2 miles per day:

No. of Men.	Occupation.	Rate per day.	Amount.
15	Running iron car	$1.75	$26.25
2	Unloading iron	1.75	3.50
24	Spiking	1.75	42.00
8	Strapping	1.75	14.00
5	Spacing ties and "squaring" joints	1.75	8.75
4	Lining track	1.75	7.00
7	Setting "joint and center" ties	1.75	12.25
2	Carrying gauges	1.75	3.50
2	Distributing spikes	1.75	3.50
1	Caring for tools	1.75	1.75
42	Bedding ties	1.40	58.80
12	"Nippers"	1.40	16.80
18	Handling ties	1.40	25.20
2	Stretching tie line	1.40	2.80
4	Carrying water	1.40	5.60
1	General foreman	3.33	3.33
1	Foreman iron car	2.50	2.50
1	Foreman tie bedding	2.50	2.50
1	Foreman handling ties	2.50	2.50
1	Foreman track lining	2.50	2.50
1	Foreman spiking gang	2.00	2.00
10	Extra men	1.40	14.00
	22 teams hauling ties	3.50	77.00
	1 team hauling iron car	3.50	3.50
164	Cost for labor only of *laying* 2 miles of track		$341.53

Force for surfacing 2 miles of track per day:

No. of Men.	Occupation.	Rate per day.	Amount.
1	Foreman	$2.50	$2.50
1	Foreman raising track	2.00	2.00
2	"Back bolters"	1.75	3.50
80	Shovelers	1.40	112.00
	SUMMARY.		
84	Cost, for labor only, of surfacing 2 miles of track		$120.00
	Cost, for labor only, of laying 2 miles of track		341.53
	Sup't of tracklaying		5.00
	Timekeeper		3.00
	Train and engine crews		15.04
	Engineering		10.97
	Total cost, for labor only, of laying and surfacing 2 miles of track		$495.54
	Cost per mile		$247.77

Electrolytic Manufacture of Copper Pipes and Tubes —Elmore's Process.

The progress of electrical processes is rapidly transforming mechanical industries. One of the most interesting applications is the electrolytic fabrication of copper tubes and pipes, such as those required for high-pressure steam engines, for which the ordinary process of manufacture with brazed joints is unsafe.

Two recent explosions of copper pipes with brazed joints, under a pressure of 150 lbs. per sq. in., have induced the officials of Lloyd's Register to have the matter investigated by a distinguished naval engineer, Mr. W. Parker, who has recently published the results of his examination. Mr. Parker's investigations have shown that copper heated to a high temperature loses its strength and becomes very brittle. As the pipe is very hot during the process of brazing, it may crack at this time, and although the rupture is not visible and may not be discovered by a hydraulic test when cold, the temperature of 360 deg. Fahrenheit and the corresponding pressure of the steam, may break the pipe. Hence there is a constant risk in using brazed copper pipes of large diameter. Several methods of avoiding this danger have been proposed, but the best consists in the use of copper pipes made by electrolysis, according to Mr. W. Elmore's system.

A revolving cylindrical mandrel is fitted in an electrolytic bath containing a solution of sulphate of copper, and bars of Chili copper are placed around the mandrel. The copper bars are connected with the positive pole of a dynamo, and the mandrel with the negative pole. The copper is deposited upon the mandrel, and when it attains the desired thickness the tube is withdrawn, being thus made without joints or seams. But the refined copper thus deposited would be deficient in tenacity and ductility were it not for the ingenious device of polishing the surface with a burnisher as the deposit is made. The burnisher, of agate, presses lightly upon the copper surface, and moves from one end to the other of the revolving mandrel, the velocities of the mandrel and burnisher being regulated so that all the surface of the deposit is polished by the burnisher, and the thin layers deposited between two passes of the tool are properly burnished, acquiring the necessary mechanical qualities. The impurities of the copper which is electrolyzed and refined by the same operation fall to the bottom of the bath, under the form of matallic dross, and are withdrawn for treatment to extract their valuable components.

In experiments made by Mr. Parker at the Elmore shops, Cockermouth, a pipe having a thickness of $\frac{3}{16}$ in. was made in 170 hours. As the burnisher does not act at the extremities of the mandrel, it is easy to compare the quality of burnished copper with that which is not touched by the burnisher during the electrolytic operation.

With regard to the tensile strength, the resistances to rupture of the polished electrolytic copper, of wire-drawn copper and rolled copper, are represented respectively by the numbers 23.75, 20 25 and 14.

The electrolytic copper is also the most ductile, the contraction being limited to the vicinity of the point of rupture. The contraction of the wire-drawn copper being 12 8 per cent., that of rolled copper is 45 per cent., and of polished electrolytic copper, 72 per cent.

At the temperate of 360 deg. Fahrenheit—ordinary steam temperature in modern engines—the resistance to rupture of the electrolytic pipes is 50 per cent. greater than that of pipes with brazed joints. Other advantages of this process consist in the possibility of making pipes of any desired diameter, of uniform thickness, and of constant density and strength throughout their whole extent. The quality of the copper deposited can be modified at will, by changing the speed or pressure of the burnisher; and since there is no brazing, the high temperatures which reduce the strength of the copper are avoided.

A correspondent of *Engineering*, who has visited Mr. Elmore's shops at Cockermouth, makes an interesting comparison between this factory—so clean, silent and well ventilated, having walls covered with blooming roses—and the copper works at Swansea, where the sulphurous and empoisoned atmosphere destroys all vegetation in a circuit of several miles.

This correspondent, Mr. C. J. Simmons, estimates that a current of 6040.8 ampères acting during 144 hours can deposit a ton of copper, by the expenditure of four electric horse-power at a tension of ¼ volt, allowing for the electric resistance of the bath and polarizing force due to its impurities. Assuming that a horse-power can be produced for 3 lbs. of coal per hour, and that the efficiency of the electric plant is 50 per cent., it appears that each ton of copper pipes will only require 1.71 tons of coal for the electrolytic process. This method of making copper tubes was briefly described in the *Railroad Gazette* of June 15, 1888.

Rotary Engines.

An attentive examination of the patent list at once reveals the astonishing amount of effort among inventors devoted to the production of rotary steam engines, an effort in the main expended upon false grounds, and in consequence of illusive hopes.

Rotary engines have a well defined and exceedingly important position for practical purposes, which we would not for a moment attempt to minimize, but their true position will be rendered all the more evident and secure by an attentive examination of the common fallacies respecting them. We are well aware that such fallacies are clearly understood by many of our practical engineers and by all of our leading engineers, but nevertheless it may save some ingenious but mistaken inventor much thought and useless labor if we point out clearly the errors respecting rotary engines, as well as their true position in engineering work.

At first sight it seems very likely that power should be lost by reciprocating in the common form of piston engine, but a little consideration will prove that this is not the fact. Take, for instance, the case of an engine where the piston, piston rod, cross-head, and connecting rod—in fact, all the reciprocating parts—weigh together 5 cwt., and suppose that the highest piston speed—not the average—is 600 ft. per minute; then the total energy contained in the whole moving mass at the instant of maximum velocity is about 870 ft.-lbs. If the stroke be of such length that 250 revolutions per minute are made, then, as the direction of motion is changed 500 times per minute, if power be lost by change of direction, then the total possible loss is 870 × 500 = 435,000 ft.-lbs. per minute, or about 13 horse-power. That is, if the whole power expended in giving the piston motion from the beginning to the middle of the stroke is lost in reversing the motion when the piston reaches the end of its stroke, that is the amount of power which would be lost in such an engine. But inventors seem to forget that if work requires to be done to give the piston velocity, it, on the other hand, must do work in order to lose velocity and come to rest. The work done in the early part of the stroke in giving the piston velocity is returned to the crank pin at or before the end of the stroke. This is more easily understood if we suppose, for a moment, that our engine is driven round by a belt at its full speed with the cylinder covers off, so that there may be no pressures or resistances generated save those due to movement. Here the piston is entirely driven from the crank pin, and whatever pressures come upon the pin are due to the reciprocating parts alone.

The real function of the best type of rotary engine is not to save fuel, but to save space. Provided that the pistons of rotary engines are as steam-tight, and are arranged to use steam as expansively as in ordinary engines, there is no reason why they should not be as economical; but, as a matter of fact, few such engines are economical. Their advantages lie in high speeds, small bulk, and consequently, great power—not in economy. Very few can be considered as truly rotary—that is, nearly all of them contain some part which reciprocates, and in many so-called rotaries the pistons themselves have a relative reciprocating motion. The commonest type, in patent specifications at least, contains a revolving piston within a cylinder and a reciprocating shutter, which serves as an abutment or cylinder bottom, and moves to and fro relatively to the cylinder. Another type has a spherical cylinder and flat piston, with spherical periphery, which has a combined revolving and reciprocating motion. The well-known Tower spherical engine is a good example of this kind, in which the mechanical difficulties are most ingeniously overcome, and a steam-tight piston secured without useless friction under most trying conditions.

Perhaps the most truly rotary engine is Parson's steam turbine, from which enormous velocities and good power can be obtained in very small bulk, and a fair measure of economy as well. Mr. Rigg's beautifully conceived revolving steam engine is not really a rotary but a reciprocating engine, where the reciprocations are relative, not actual, and on which any actual reciprocation appears not in the cylinders and pistons, but in the connecting rods. Consequently enormous velocities may be obtained without vibration.

These and many other rotary, or partly rotary, engines are very admirable examples of what can be done by ingenious design and first-class workmanship to solve the difficult problem of attaining high velocity of rotation and great power in a very small space, but in not one of them is the economy of steam nearly so good as is attained easily in the best types of reciprocating engine. At best the complexity and nature of the working part in such engines render them more expensive in first cost, and less easily kept in order, than the ordinary reciprocating piston type. This is readily understood when we consider the difficulty of getting steam-tight pistons working easily against the various surfaces required in such engines.—*The Practical Engineer.*

TECHNICAL.

Locomotive Building.

The Brooks Locomotive Works have received an order from the Lake Erie & Western for three mogul locomotives.

Two new mogul passenger engines from the Rogers Locomotive Works were received last week by the Nashville, Chattanooga & St. Louis.

The Rhode Island Locomotive Works delivered two new engines to the Union Pacific last week.

At the annual meeting of the stockholders of the Taunton Locomotive Works, R. I. Gammell was re-elected President, and William R. Billings was chosen Corporation Clerk and Treasurer.

Car Notes.

The first installment of the 750 additional ventilated fruit cars, ordered by the Central of Georgia recently, has been received from the United States Rolling Stock Co.'s Anniston works.

The Wason Car Mfg. Co., of Springfield, Mass., has just finished five cars for the Brooklyn, Bath & West End road. The cars are of open style, for summer travel and excursion trains.

Thirty new freight cars were received by the Louisville, St. Louis & Texas road last week.

Since winter 20 box cars and several passenger cars have been finished at the Waterville shops of the Maine Central.

The Ohio Falls Car Co. has secured contracts to keep its passenger department busy for the next ten weeks, and has also been awarded a contract to build 200 box cars and several cabooses for a Southern road, and is negotiating for a contract to build 500 cars for another Southern line.

Bridge Notes.

The selectmen of Great Barrington, Mass., have contracted with the Berlin Bridge Co. for the erection of a new iron bridge across Williams River.

Work upon the abutments of Kenduskeag bridge, at Bangor, Me., for which $10,000 was appropriated by Congress, will probably begin some time in July. The Groton Bridge Co. has the contract.

J. T. Thomas, Grenada, Miss., will receive bids until July 1 for constructing an iron bridge near Tuscahoma ferry.

An iron bridge costing $2,180 has just been completed at Attala, Ala., and contracts will soon be let for one 200 ft. long.

Proposals are wanted for constructing an iron approach to bridge, a length of 410 ft. Address G. C. Shelden, Houghton, Mich.

The city of St. Cloud, Minn., has authorized an issue of bonds to the extent of $80,000 to build bridges.

An iron bridge is to be built at Windsor Locks, Conn., by the canal company.

The A. C. Bayne Mfg. Co., of Minneapolis, has been given the contract to build three small iron bridges near Bismarck, Dak.

Manufacturing and Business.

Recent sales of the Dunham storm proof door have been made to the following roads: Atchison, Topeka & Santa Fe; New York Central & Hudson River; Northern Pacific; Union Pacific; Marietta & North Georgia; Central of New Jersey; Milwaukee, Lake Shore & Western, and Cleveland, Columbus, Cincinnati & Indianapolis.

Shailer & Schniglau, engineers and contractors, of Chicago, have been awarded the contract for building the water tunnel, shore and lake shafts, crib, light-house and electric machinery for the city of Lake View, Ill. The tunnel is to be 6 ft. in diameter, and to extend under Lake Michigan 5,000 ft. The contract price is $159,650, and the work is to be commenced at once.

The Ingersoll-Sergeant Rock Drill Co., of New York, has recently made foreign shipments of complete mining plants to South Africa and Japan. The company has a large exhibit of rock drills, air compressors, channeling machines, etc., at the Paris Exposition.

A certificate has been filed at Albany, N. Y., by the Sprague Electric Railway & Motor Co., of New York, for an increase of its capital from $1,000,000 to $1,600,000, $400,000 of which is to be preferred.

The Louisiana & Texas Construction Co., with a capital stock of $100,000, has been incorporated to build railroads, etc., by E. W. Taylor, M. C. Hurley, of Fort Worth, Tex., and others.

John W. Good and L. McGilvray have formed a partnership as manufacturers' agents, and established themselves in the Laclede Building, St. Louis, Mo. Among the firms repre-

sented by them are P. L. Kimberly & Co., Sharon, Pa.; Standard Iron Co., Bridgeport, O.; Lawrence Iron & Steel Co., Ironton, O., and the Calumet Iron & Steel Co., Chicago, Ill.

The Ishpeming Vulcan Steel Welding Co. has begun the erection of works at Ishpeming, Mich. The company will manufacture its compound in eight states, and will employ a large force of men when the buildings are completed.

The Wisconsin Central has ordered a number of the largest size Globe ventilators for its new passenger station now under construction in Chicago. The Dunham Manufacturing Co. also reports orders received during the past few days for Globe ventilators from the following roads: Boston & Maine, Missouri Pacific, Chicago & Eastern Illinois, Housatonic, Pennsylvania, New York & New England and New York Central & Hudson River roads.

Henry R. Worthington has just opened a branch office at 338 Sibley street, St. Paul, Minn.

The Widdifield & Bowman Electric Brake Co. has opened an office at Room 125, Temple Court, New York City.

A receiver has been appointed for the Waldumer Electric and Magnetic Brake Co., of Cincinnati, Ohio.

Iron and Steel.

The American Tube & Iron Co., of Middletown, Pa., has contracted with the Pittsburgh Plate Glass Co. to supply immediately all the pipe necessary for that company's 8-in. gas line from the Ruff Run field to its Ford City Works, 12 miles.

The Columbia Steel Co., of Pittsburgh, with works at Uniontown, Pa., is making additions to its works, in the shape of open-hearth furnaces.

The A. Garrison Foundry Co., at Pittsburgh, Pa., will erect an open-hearth furnace in that city for foundry use.

The Monongahela Furnace Co. was permanently organized at McKeesport, Pa., last week. The corporation is composed of the stockholders of the National Tube Works Co., and it will erect two of the latest improved furnaces, each with a capacity of 250 tons daily, at McKeesport, Pa. The pig-iron produced will be used by the National Tube Works Co. and the Republic Iron Works, Limited.

On May 16 there were shipped from the Homestead Steel Works of Carnegie, Phipps & Co., Limited, two large steel plates for Government ships. They were 3 in. thick, 9 in. wide and 206 in. long. Each plate weighed 13,000 lbs. The plates were bent in a semicircle, and are to be used round the pilot-houses of large gunboats. The work of bending them was done while the plates were cold—the first attempt ever made at such work in the United States. It was so successfully accomplished that the firm is getting ready to fill six more orders of a similar nature. On May 18 there were turned out at this plant two plates 96 in. wide, 180 in. long and 3 in. thick. Each plate weighed 9,000 lbs. The plates were tested to 60,000 lbs. tensile strength and to an elongation of 20 per cent. in 8 inches.

The South Chicago mill, of the new Illinois Steel Co., is full of work, running night and day. The company expects to start up the Union Steel Mill on steel rails soon, and the Joliet Mill has all the work it can do up to next winter.

The Roanoke Rolling Mill will be in full operation by June 15. The machinery, in part, was started about May 15 and is giving good satisfaction.

P. J. McArdle, who recently bought the Jagger Iron Works at Van Rennselaer Island, N. Y., will soon commence the erection of a rolling mill on the property. A stock company will be formed. Between 500 and 1,000 men will find employment in the mill.

The Bates Steel Co., of Philadelphia, Pa., has been chartered, with a capital of $100,000. The incorporators are John F. Bickle, Morton, Pa.; Lewis Wiener, Augustus Hunt, Edward P. Kershow, F. G. Bates, Philadelphia, and others.

The furnace of the Bellefonte Furnace Co., at Bellefonte, Pa., has been blown out after a successful run of 17 months. The stack will be relined, and work will not be resumed for two months.

The Keystone Rolling Mill, at Reading, Pa., which has been idle since the failure of the Reading Iron Works, will, it is reported, start up soon to run independent hereafter of the Reading Iron Works, and find a market for its product around Pittsburgh.

The Navy Department has completed and will soon issue advertisements calling for proposals for the construction of three new cruisers slightly larger than the "Yorktown" and of 2,000 tons burden. The limit of cost fixed in the appropriation act is $750,000 for each vessel. As they will be longer than the "Yorktown," it is expected that they will be more powerful and faster.

The appraisement of the property of the Reading Iron Works, which failed nearly three months ago, was filed in court at Reading, May 24. The personal property is appraised at $566,568, and the real estate at $715,042, a total of $1,281,610. The personal property includes all the material on hand, finished goods, etc. There is a mortgage of $600,000 on the works, and after the payment of this, according to the appraiser's figures, there will be left $681,610 for the creditors. The estimated claims of all the creditors are over $1,500,000.

The Shiffler Bridge Works, of Pittsburgh, Pa., have been awarded the contract for building a bridge across the Kentucky River, near Tate's Creek Ferry, Ky., for the Richmond, Nicholasville, Irvine & Beattyville road. The channel span of the bridge will be 300 ft. long, and iron cylinders will be used in building it. The same company has also the contract for building bridges for the same road over Marble, Hickman and Neals creeks. The contract price for the four bridges is $151,000.

The Canadian Pacific has let the contract for building the bridge over the Fraser River, on the branch from Mission toward Seattle, Wash., to D. McGillivray.

The Tennessee Midland will soon commence work on a bridge across the Tennessee River, to be 1,400 ft. long, with 200 ft. spans.

Deoxidized Bronze.

The various metals made by the Deoxidized Metal Co., of Bridgeport, Conn., are used for a variety of purposes. The deoxidized bronze as a journal bearing metal is widely used, and is strong, durable and economical of lubrication. The same metal is much used for locomotive bells, and for ornamental hardware. The company makes a variety of anti-friction metals, including the deoxidized white bronze babbitt. The works of the company are equipped with 23 crucible melting holes, which are to be supplemented in the near future with a large reverberatory furnace, to be heated with oil, capable of melting 10,000-lb. charges. The foundry is to be enlarged by the addition of a building on adjoining property recently acquired, which is to be 80 × 130 ft., and is to be used chiefly for heavy loam work. Until now the largest castings of deoxidized bronze made were the rings of digesters for the bisulphite wood-pulp process, which weighed 8,500 lbs. Soon larger digesters are to be made, weighing 45,000 lbs., the company having orders for 19 of these large and 17 small digesters. The fact that the use of the flux employed in melting by the company does remove the sub-oxide of copper, so fatal to sound castings of copper alloys, is proved by the following analyses of Calumet & Hecla copper and deoxidized copper:

	C. & H. 1	C. & H. 2	C. & H. 3	Deoxidized.
Metallic copper	99.854	99.63	98.10	99.89
Sub-oxide of copper	0.293	0.324	1.95	0.07
Iron	0.015	0.011	....	0.01
Tin	0.021	....	....	0.01
Silver	0.012	0.024	0.03	0.02
Phosphorus	trace	....	trace	....

Tests of the Van Dorston Coupler.

A test of the new Van Dorston cushioned coupler was made on the Philadelphia & Reading road at Wayne Junction, near Philadelphia, on the 25th inst. Among the railroad men present were I. A. Sweigard, General Superintendent, M. F. Bonzano, Superintendent, and I. T. Bassert, Assistant Superintendent, New York, Philadelphia & Bound Brook Division; L. B. Paxson, Superintendent Motive Power, J. H. Rankin, Master Car Builder, C. F Kindred, Assistant to General Manager, of the Philadelphia & Reading; A. Feldpauche, Engineer Maintenance of Way, and J. M. Wallis, Superintendent Motive Power, of the Philadelphia, Wilmington & Baltimore, and others.

The train consisted of three platform cars equipped with the new coupler, and two box cars having the Janney.

On arriving at Wayne Junction the cars were switched to a side track and the test was begun under the supervision of the inventor, Mr. A. W. Van Dorston. Several trials were made with speed varying from 8 to 20 miles an hour, and in every case the improved coupler sustained the shocks well and remained in perfect working order. There was no failure to couple, except on one very sharp curve, said to be of 75 ft. radius.

All present expressed satisfaction with the result of the tests.

After the exhibition, at the invitation of the Van Dorston Co., the entire party adjourned to Boothby's café, where a very enjoyable informal banquet was served. This coupler was fully illustrated and described in the *Railroad Gazette*, Dec. 14, 1888, and an account of tests made Sept. 18, 1888, at Columbus, O., was also given.

The Nicaragua Canal.

The Atlas Line steamer "Alvena" left New York city May 25 at noon for Greytown, Nicaragua, carrying some fifty men and a quantity of stores and material for the Nicaragua Canal Co. Other vessels will follow at short intervals, and it is intended to proceed vigorously with the construction of the canal. Temporary quarters have been built for the men. The first work to be done is the building of a pole railroad and the erection of permanent living quarters, hospitals, warehouses, shops, a telegraph line, dredging the entrance to the harbor of Greytown and of the first twelve miles of the canal from Greytown to the divide. The supplies and material taken on this trip consisted principally of a pole-road locomotive from Richmond, Va., ten large steel canoes, a steam launch, four large Rand drills and four Ingersoll drills, telegraph materials, engineering instruments, clothing, cots, etc. Dredgers, excavators and other large machinery will probably not be shipped until fall, when it is expected that the preparatory work will be finished. A permanent railroad will also be constructed.

On board the "Alvena" are Lieut. N. R. Usher, U. S. N., Assistant Superintendent of Supplies and Master of Transportation; J. B. Harris, Superintendent of Railroad Construction; Resident Engineer Frank P. Davis, Second Assistant Engineer S. J. Johnson, eight third assistant engineers, five levelers and several rodmen and chainmen; also Chief Draughtsmen Wm. Bauman and Assistant Surgeon W. M. Barnum.

The Chicago Drainage Scheme.

Both houses of the Illinois Legislature have now passed the Chicago Drainage bill, appropriating sixteen million dollars to dredging a channel 160 ft. wide and 18 ft. deep from the south branch of the Chicago River through to Desplaines, which is one of the head-waters of the Illinois, which channel shall have a capacity of not less than 600,000 cu. ft. per minute. The cutting is intended to both cleanse the Chicago River from the sewage which for the past thirty years has defiled it, and at times by drifting out into the lake has also seriously polluted the city's drinking water, and to open a practicable waterway for the steamboats on the lower Mississippi to the docks of Chicago. The Illinois & Michigan Canal, between Chicago and the head of steamboat navigation on the Illinois River at La Salle, with 4½ ft. of water and locks 110 ft. × by 17 ft., opened in 1848, was an improvement in transportation on the "prairie schooners," which it displaced, but was of no appreciable influence as an artery of distribution after the completion of the Chicago & Rock Island Railroad, between Chicago and La Salle, in the spring of 1854.

In addition to the two above mentioned results from the proposed improvement, there will be a decided addition to the available dock frontage for lake steamers and sailing craft, and the 10,000 cu. ft. per second will add an effective increase to the low water flow of the Mississippi below Grafton, where the Illinois joins that river. On the other hand, the expenditures on the locks and dams, built and partially completed, in the Illinois River, will be to a great extent rendered useless, as the additional volume of water will, it is understood, render the Illinois below La Salle as navigable as the Mississippi.

New Machine Shops.

W. A Chesterman, of Richmond, has been awarded a contract to build an addition to the machine shops of the Richmond & Allegheny in Richmond.

W. B. Snead & Co. have contracted to build new machine shops at Lynchburg, Va., for the Lynchburg & Durham.

The Richmond & Allegheny is building a round house and machine shop at Gladstone, Va., which will be completed by July 1.

The Newport News & Mississippi Valley Co. is now building new shops at Memphis, Tenn. The buildings include machine and car shops and a roundhouse. It is also enlarging the old yard and building a new one. The work is to be completed by September. The company has bought 1,600 acres of land at Clifton Forge, Va., and it is said will build large machine shops there.

The Kentucky Central has conveyed all its tanks, shops and contents, at Covington, Ky., to the Chesapeake & Ohio for $350,000.

A company is being organized at Pulaski, Va., to manufacture cars, car wheels, and to erect a cold blast charcoal iron furnace.

A New Steamer.

At Roach's shipyard, Chester, Pa., a new steamer has been laid down for the Old Colony Steamboat Company, which will be about the size of the "Pilgrim," her total length over all being 363 ft.; she will, however, have more staterooms than that vessel, and will be used in winter as a companion to the steamer "Providence."

Long Engine Mileage.

Engine No. 9, on the Indianapolis, Decatur & Western road, has run 139,990 miles without any repairs of importance or being removed from its wheels. Master Mechanic McKenna says that he proposes to let the engine run 20,000 miles more, and then take it into the shop.

Wood Pulp Gaskets.

Attention is called to the employment in France, for steam and water pipe joints, of gaskets made of wood pulp, which are claimed to be more economical than the ordinary rubber gaskets and are not subject to decomposition by high temperatures. Care is taken in the preparation of the pulp to select woods free from ingredients which might attack metals. The compressed pulp gaskets are boiled in linseed oil, and in practical use have given, it is said, very satisfactory results.

Compressed Air Distribution at Paris.

In connection with the system instituted at Paris some six or seven years ago, and widely noticed since then, of distributing power through underground mains in which a partial vacuum is maintained by air pumps at a central station, it is interesting to note that a compressed air system has also more recently been developed in that city, and is now, according to all accounts, meeting with general success. The company prosecuting the undertaking is known as the "Compagnie Générale des Horloges et Forces Pneumatiques," and commenced operations on a modest scale a number of years ago, when it confined itself to the pneumatic transmission of time. In 1886 the company was reorganized on a larger scale and obtained a concession for forty years to distribute power by compressed air. A plant of 3,000 horse-power was installed at Belleville, and the work was pushed to such an extent that in addition to a network of 39 miles of tubing given up to clock service, there are now 33 miles of underground mains conveying the compressed air for power purposes.

The two principal power mains measure 11¾ in. in diameter. In the fall of 1888 six electric light central stations, each embracing 100 horse-power, and three others of 50 horse-power each, were supplied with power by the company, and since then numerous smaller electric plants, aggregating 350 horse-power, have been added. Besides these the company furnish air to a large number of other establishments, such as saw-mills, artificial ice works, printing rooms and others. A large field for the work of the company is made available by the circumstance, not perhaps peculiar to Paris alone, that there are many small industries requiring comparatively small powers which, if furnished by independent boilers and engines, constitute relatively large items of expense, so large as to make any other reasonably cheap substitute highly welcome. These small industries have nearly all, where possible, availed themselves of the advantages of the compressed air system.

Financially also, we are told, the success of the company is assured. Further concessions to extend the system have been granted by the municipal council of Paris, and its wider application, therefore, seems a question of but a short time. The new districts to be opened will require a large proportion of the power for electric lighting and the company is said to already have contracts in them for supplying not less than 150,000 lamps.

A New Non-magnetic Alloy.

A new alloy has recently been brought out in Geneva, Switzerland, by Messrs. Ostermann and Lacroix, to be used as a substitute for steel in the manufacture of different parts of watch mechanism, such as, for example, hair springs and balance wheels which are apt to cause a good deal of annoyance through becoming magnetized. The alloy, we need, therefore, perhaps scarcely say is claimed to be non-magnetic. It is made up of from 30 to 40 parts of gold, from 30 to 40 parts of palladium, 0.1 to 5 parts of rhodium, 10 to 20 parts of copper, 0.1 to 5 parts of manganese, and the same proportion of silver and of platinum. The copper and manganese are first mixed, after which the other metals are added, or all the metals may be put into a crucible at the same time, the manganese being used for the bottom layer.

Standards in Testing Materials.

Standard methods of testing materials were recently discussed at some length before the French Society of Civil Engineers, special attention being directed to the methods practiced in the testing laboratories of some of the more prominent French railroad companies. To the different practices in these was largely attributed the prevailing lack of unanimity of opinion as to the fitness of different materials, such as, for example, high and low steels for special uses. That uniformity in the manner of conducting such tests was highly desirable was very generally conceded, and while it was perhaps too much to expect at once the formulation of a definite plan of action in endeavoring to attain this end, it is interesting to note that the subject will again be taken up at an early date and its general discussion invited. From this some interesting and valuable information may reasonably be expected.

Steam Hammers vs. Forging Presses.

In his inaugural address, as President of the Iron and Steel Institute, Sir James Kitson says: "A reference to the steam hammer has a special interest at this moment, as it is a tool which appears to have reached its fullest development," and gives a list from Messrs. A. & C. Casolonga's memoir on steam hammers, of the heaviest hammers in Europe. England has one 30-ton hammer and one of 35 tons, double acting. There is one 50-ton hammer in Germany and one in Russia of the same weight. In France there are two 100-ton, one 80-ton, one 50-ton, two 40-ton, one 35-ton, with three 25-ton and four 20-ton hammers, all double acting. The reason for this array of steam hammers in France is that the French government has encouraged their construction by continuous contracts for heavy artillery.

The forging capacity of England is not represented by steam hammers, as hydraulic forging presses in the works of Whitworth, Vickers, Brown and Cammell do, it is claimed, superior work to that accomplished by hammers. Sir James Kitson reasons that the effort of the hammer is abrupt and the force of the blow is absorbed to a great extent on the surface of the forging, and if the hammer is not up to its work piping is apt to result; with the press of 4,000 or 5,000 tons, however, the action is described as "silent, slow working and irresistible," and it is held as certain, as the hammer cannot develop in its fall the full amount of energy stored up in raising it, that a press of less than 3,500 tons power would be equivalent to a 100 ton hammer.

RAILROAD LAW—NOTES OF DECISIONS.

Powers, Liabilities and Regulation of Railroads.

In Colorado the Federal Court refuses to restrain the exercise of a right, acquired by regular condemnation proceedings in a state court to extend one railroad across another, where the complaining company, citizen of another state, has the possession and management of the road over which the right of way was condemned, by virtue of its ownership of a majority of the stock, since, if not bound, as a stockholder, by the decree of the state court, it could have made itself a party to those proceedings for the protection of its rights.[1]

In North Carolina the Supreme Court rules that a railroad which has instituted condemnation proceedings against three persons to take land, and paid the money therefor into court, is not estopped from disputing, in a collateral action, the title of one of such persons.[2]

In Iowa it is held by the Supreme Court that where a railroad is located across a block of land in a town site, which has been platted into lots, the measure of damages to the owner of the block is the difference in the value of the whole block before and after the location, and not merely the difference in the value of the lots over which the road actually passes.[3]

The Supreme Court of Nebraska rules that the rule for estimating damages to real estate, resulting from the construction of a railroad contiguous or adjacent thereto, is the difference in the value of the real estate before and after the construction of the railroad, uninfluenced by the increase or depreciation of the property values generally in the neighborhood.[4]

A Missouri statute provides for the assessment of bridges of joint stock companies and bridges for crossing which a toll is charged. Other sections provide for the assessment of all property of railroad companies, the road and rolling stock to be assessed as a whole. The Supreme Court rules that a bridge forming part of a railroad must be assessed with the road, and not as a separate structure, though it is used also for the passage of carriages and foot passengers, for which tolls are charged.[5]

The Supreme Court of Texas holds that a conveyance by a railroad company of "all and singular the chartered rights, privileges and franchises of every kind" belonging to, or which should thereafter belong to, the grantor, does not include land grants which are not directly connected with the operation of the road.[6]

Injuries to Passengers, Employes and Strangers.

In Texas a woman in pregnancy was seriously injured in boarding a train at a regular station. She was obliged to step from the ground to a height of 30 or 36 inches, no intervening step being provided, as was the custom. She used due care with the means provided. The Supreme Court affirms a verdict against the company, though it also appears that she had some assistance from the company's employés, and that other women, and possibly at times she herself, had boarded the train in a similar manner without injury.[7]

In Missouri a man was killed by the derailment of a train, which was a special freight, consisting of an engine, tender, one box, and several flat cars. He and others were riding on a flat car next to the engine, sitting on an improvised seat. The conductor and brakeman knew they were there, and did not warn them that it was dangerous; nor was there danger if the train had not been derailed. Both the conductor and a brakeman told them it was more comfortable in the box car, but they preferred to ride on the flat car. The road was rough, and the engine and tender were reversed, which was dangerous on a rough track, and the train was running too fast for safety, from which facts the accident resulted. The man was thrown on the track and killed, no one being injured except those on the flat car. The Supreme Court holds that the man was not negligent, and his representatives have a right of action against the company.[8]

In Dakota the plaintiff was employed by the railroad as a shoveller, and was engaged in loading cars from a gravel pit, under the direction of a foreman. An embankment of earth had been formed by the removal of gravel under it, 12 or 13 ft. high, and was frozen. The foreman, with the knowledge of plaintiff, attempted to pry the bank down, and while he was thus engaged plaintiff selected a place for continuing his work, from which the foreman was in full view, and which he considered far enough removed from the bank to insure his safety, though it should fall. As the bank began to fall plaintiff attempted to retreat further, stumbled over a clod of earth and fell, and was caught by the falling earth, and his leg broken. The Supreme Court rules that the defendant is not liable.[9]

In Missouri a track hand, while standing on the track watching some men loading cars with a steam shovel, was struck by the locomotive of a passenger train, which came around a curve, on a down grade, at the rate of from 20 to 35 miles per hour. Intestate could have seen the locomotive, and been seen by the train-men, for a distance of about 200 yards. A witness for plaintiff, who saw the locomotive distant about 150 yards, testified that no signal was given or effort made to stop the locomotive until intestate was struck. The fireman, who saw intestate when at a distance of 100 yards, and the engineer, who saw him at 50 yards, testified to signals and efforts to stop the locomotive. They also knew that men were working at this point on the road. The Supreme Court affirms a verdict against the company.[10]

The Supreme Court of Pennsylvania rules that a railroad company in permitting the accumulation of snow and ice in moderate quantities on the platforms of its cars during a night run in a storm of snow and sleet, is not guilty of such negligence as would warrant a recovery for injuries in consequence thereof, particularly by one cognizant of the condition of the platforms.[11]

In Nebraska the Supreme Court holds that a railroad is responsible for the personal baggage of a passenger delivered to and received by it solely for transportation, and not for storage, although for the convenience of the carrier the passenger consents to some delay in the transportation.[12]

In Texas it appears that plaintiff was confined in a hospital for 145 days; that dead bone was at the time of the trial (21 months after the accident) still working out of the wound, which was still open; one leg was partially stiffened, and somewhat shorter than the other; and he was disabled for life; his leg had been broken; large pieces of skin were torn from the flesh; and he was bruised in many places. The Supreme Court holds that a verdict of $14,167 was not excessive.[13]

The Court of Appeals of Connecticut rules that the state statute providing that the engineer of every train shall within 80 rods of any grade crossing sound the whistle or ring the bell, is substantially complied with when the whistle is blown within 45 rods from a crossing at a point best adapted, on account of the topography of the country, for conveying the sound, and in such case the railroad company is not liable for injuries caused by a team on the adjoining highway becoming frightened by the whistle.[14]

In Texas the plaintiff while driving across the track first saw the train when he was in the centre of the track; it was then about 390 ft. away, and going at the rate of 40 miles an hour. The Supreme Court holds that he must have been guilty of contributory negligence in failing to cross the road before the train struck him. [To clear the train he would have been obliged to get off the crossing in about 6 seconds.—EDITOR.][15]

In Maryland the deceased was walking on defendant's track at a point in a city which was defendant's private right of way, and on a footpath used, however, by the people of the neighborhood only with defendant's implied license. A train was approaching in front of deceased, and when it was within 150 ft. of him he crossed diagonally to the side of the track and pursued his way on the ends of the cross-ties, when he was struck and killed. The train could have been seen 1,000 ft. from the place of the accident, and others heard it and heeded it. The Court of Appeals decides that, though the train was running at a higher speed than allowed by ordinance, the death was caused by deceased's own negligence, and a verdict for defendant should have been ordered.[16]

The Supreme Court of Michigan holds that if through negligence of a railway company, sparks and cinders escape from its engine, and set fire to a house, the company is liable for all the loss of life, as well as property destroyed by such fire.[17]

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1 U. P. R. Co. v. D. & G. R. Co., 37 Fed. Rep., 179.
2 Ely v. Norfolk South. R. Co., 8 S. E. Rep., 779.
3 Cox v. M., C. & Ft. D. R. Co., 41 N. W Rep., 474.
4 O. B. R. Co. v. McDermott, 41 N. W. Rep., 648.
5 State v. H. & St. J. R. Co., 10 S. W. Rep., 436.
6 Shirley v. W. T. R. Co., 10 S. W. Rep., 543.
7 Mo. Pac. R. R. Co. v. Watson, 10 S. W. Rep., 731.
8 Wagner v. Mo. Pac. R. Co., 10 S. W. Rep., 486.
9 Songstead v. B., C. R. & N. R. Co., 41 N. W. Rep., 755.
10 Sullivan v. Mo. Pac. R. Co., 10 S. W. Rep., 852.
11 Palmer vs. Penn. Co., 18 N. E., Rep., 859.
12 Shaw vs. N. P. R. Co., 41 N. W. Rep., 548.
13 Galveston H. & S. A. R. Co., v. Porfert, 10 S. W. Rep., 207.
14 Bailey v. H. & C. V. R. Co., 16 Atl. Rep., 234.
15 G., H. & S. A. R. Co. v. Porfert, 10 S. W. Rep., 207.
16 Balt. & O. R. Co. v. State, 16 Atl. Rep., 212.
17 Rajonwski v. D., B. C. & A. R. Co., 41 N. W. Rep., 847.

General Railroad News.

MEETINGS AND ANNOUNCEMENTS.

Dividends.

Dividends on the capital stocks of railroad companies have been declared as follows:

Boston & Albany, quarterly, 2 per cent., payable June 29

Catawissa, 3½ per cent. on the preferred stock, payable May 18.

Chicago, Burlington & Quincy, quarterly dividend, 1 per cent., payable June 15.

Chicago & Indiana Coal, quarterly, 1½ per cent. on the preferred stock, payable June 1.

Cincinnati, Indianapolis, St. Louis & Chicago, quarterly, 1¼ per cent., payable June 15.

Little Miami, quarterly, 2 per cent., payable June 1.

Meetings.

Meetings of the stockholders of railroad companies will be held as follows:

Canada Southern, annual meeting, June 5.

Chicago & Eastern Illinois, annual meeting, Chicago, Ill., June 5.

Chicago, Kansas & Nebraska, annual meeting, Topeka, Kan., June 12.

Chicago & Northwestern, annual meeting, Chicago, Ill. June 6.

Chicago, St. Paul, Minneapolis & Omaha, annual meeting, Hudson, Wis., June 8.

Des Moines & Fort Dodge, annual meeting, Des Moines, Iowa, June 6.

Galveston & Western, annual meeting, Galveston, Tex., June 1.

Oregon Railway & Navigation Co., annual meeting, Portland, Or., June 18.

Portsmouth, Great Falls & Conway, annual meeting, Portsmouth, N. H., June 3.

Roanoke & Southern, annual meeting, Roancke, Va., June 18.

Toledo, St. Louis & Kansas City, annual meeting, Toledo, Ohio, June 12.

Vermont & Massachusetts, annual meeting, Boston, Mass., June 5.

Railroad and Technical Conventions.

Meetings and conventions of railroad associations and technical societies will be held as follows:

The *American Railway Master Mechanics' Association* will hold its next annual convention at Niagara Falls, beginning Tuesday, June 18, with headquarters at the International Hotel. All who wish to secure rooms should apply to Mr. A. H. Gluck, Manager, International Hotel, Niagara Falls, N. Y.

The *Master Car-Builders' Association* will hold its next annual convention at Saratoga Springs, N. Y., June 25. Hotel accommodations may be secured by applying to H. S. Clement, Manager Congress Hall.

The *Train Dispatchers' Association* will hold its second annual convention in Indianapolis, Ind., June 12. E. J. Peabody, 237 Franklin street, Chicago, is Secretary.

The Association of American Railway Accounting Officers will hold its next meeting at Niagara Falls, N. Y., July 10.

The International Association of Car Accountants will hold its fourteenth annual meeting at Plank's Grand Hotel, Island of Mackinaw, Mich., June 25.

The Traveling Passenger Agents' Association will hold its next meeting in Plank's Hotel, Mackinac Island, Mich., July 9.

The Roadmasters' Association of America will hold its seventh annual convention at Denver, Colo., Sept. 10.

The New England Roadmasters' Association will hold its next meeting in Boston, August 21.

The American Association of General Passenger and Ticket Agents will hold its next semi-annual meeting in Atlanta, Ga., Sept. 17.

The National Association of General Baggage Agents will hold its next meeting at Detroit, Mich., July 17.

The *New England Railroad Club* meets at its rooms in the Boston & Albany passenger station, Boston, on the second Wednesday of each month, except June, July and August. The next meeting will be held Sept. 11.

The *Western Railway Club* holds regular meetings on the third Tuesday in each month, except June, July and August, at its rooms in the Phenix Building, Jackson street, Chicago, at 2 p. m.

The *New York Railroad Club* meets at its rooms, 113 Liberty street, New York City, at 7:30 p. m., on the third Thursday in each month.

The Central Railway Club meets at the Tifft House, Buffalo, the fourth Wednesday of January, March, May, August and October.

The *American Society of Civil Engineers* holds its regular meetings on the first and third Wednesday in each month at the House of the Society, 127 East Twenty-third street, New York.

The *Boston Society of Civil Engineers* holds its regular meetings at its rooms in the Boston & Albany station, Boston, at 7:30 p. m. on the third Wednesday in each month.

The *Western Society of Engineers* holds its regular meetings at its hall, No. 67 Washington street, Chicago, at 7:30 p. m., on the first Tuesday in each month.

The *Engineers' Club of St. Louis* holds regular meetings in St. Louis on the first and third Wednesdays in each month.

The *Engineers' Club of Philadelphia* holds regular meetings at the house of the Club, 1,122 Gerard street, Philadelphia.

The *Engineers' Society of Western Pennsylvania* holds regular meetings on the third Tuesday in each month, at 7:30 p.m., at its rooms in the Penn Building, Pittsburgh, Pa.

The *Engineers' Club of Kansas City* meets at Kansas City, Mo., on the first Monday in each month.

The *Civil Engineers' Society of St. Paul* meets at St. Paul, Minn., on the first Monday in each month.

The *Montana Society of Civil Engineers* meets at Helena, Mont., at 7:30 p m., on the third Saturday in each month.

The *Civil Engineers' Club of Kansas* holds regular meetings on the first Wednesday in each month at Wichita, Kan.

Banquet of the New York Railroad Club.

On Thursday, the 23d inst., the New York Railroad Club gave its first annual banquet at Delmonico's in New York. About 100 members and guests were present, including many well-known railroad men and the State Railroad Commissioners of New York. The banquet was very successful in all particulars. The speakers were William E. Rogers, Chairman of the New York State Railroad Commission; George Richards, President New England Railroad Club, and formerly Master Mechanic of the Boston & Providence Railroad; O. P. Letchworth, of Pratt & Letchworth, Buffalo, N. Y., representing the Central Railway Club; James N. Lauder, Superintendent Rolling Stock, Old Colony; E. N. Lewis, Editor *Railway Master Mechanic*; Dr. Waite, of the Julien Electric Co.; J. Seaver Page, Mr. Elmendorf, E. H. Andress and S. W. McMunn. Mr. Bolen, of Shipmen & Bolen, read an original poem, and James S. Burdetts gave some humorous recitations. There were several songs by the Orpheus Quartet. Mr. H. G. Prout, of the *Railroad Gazette*, presided. No stenographic report of the speeches was made.

Engineers' Club of Philadelphia.

A regular meeting was held May 18, President William Sellers in the chair, and 11 members present. The Secretary presented for Mr. C. O. Vandevanter two specimens of timber, one a section cut from a timber used in the foundation of an arch culvert on the old Tape Worm Railroad, built in 1837 and taken out in 1888. The timber has been exposed since shortly after the culvert was built.

Mr. F. J. Amweg presented an illustrated description of the Market street cantilever bridge over the Schuylkill River, Philadelphia.

The question may arise in the minds of some readers why it was that the cantilever design was selected for this place: as it may seem strange to some that a bridge of this class was chosen for highway purposes, and also for a locality where no obstacles existed for the erection of a bridge of a simpler design, I beg leave to answer this question in advance by saying that the city insisted upon having a deck bridge. A deck bridge with parallel chords would not allow sufficient clearance in the channel of river for navigation, and at the same time admit of an easy grade for roadway over the bridge The only styles that would meet these requirements were the arch or cantilever. The arch was considered objectionable on account of the thrust transmitted to the abutments, which would be difficult to overcome from the fact that it is impossible to obtain a solid foundation on the west side of the river, without incurring a great expense to the city, and also assuming the risk of the same trouble occurring again that has already taken place to other bridges in this locality. All things being considered, the cantilever design was selected as the best adapted to meet all requirements of the case, and also as the piers or abutments receive no thrust from the superstructure, it at once eliminates the trouble which might have arisen had the arch been adopted.

The bridge which is the subject of this paper crosses the Schuylkill River at Market street, Philadelphia, and connects the city proper with West Philadelphia.

To go back some years, in September, 1882, City Council directed that plans and specifications should be prepared for a stone bridge at this point. Plans were prepared by the Chief Engineer in accordance with this resolution, and bids were called for and opened on Jan. 7, 1884, as follows:

Lindenthal & Friday	$1,220,000
Smith & McGaw	1,197,000
H. C. Clark & Co.	1,160,000
R. A. Malone & Son	1,100,000

But as only $300,000 had been appropriated by Council for this work, and the limitation act made trouble in providing the additional amount required, the matter lay dormant until the Chief Engineer submitted the plans herein described. On June 15, 1886, the city of Philadelphia opened the following bids for the building complete of the entire structure:

Jones & Benner Co.	$311,000.00
Keystone Bridge Co.	308,000.00
Edge Moor Iron Co.	294,449.00
Phœnix Bridge Co.	294,205.00
N. J. Steel & Iron Co.	277,638.50
R. A. Malone & Son	271,000.00

R. A. Malone & Son being the lowest bidders were awarded the contract. On account of delays caused by the mayor vetoing the ordinance, the work was not commenced until Sept. 7, 1886.

On May 23, 1887, the masonry was entirely completed, and immediately the erection of the superstructure was started. The cantilevers were connected Aug. 30, and Oct. 28 the entire superstructure was finished, except some few matters pertaining to the track. On Feb. 15, 1888, the cable connection was made on the east-bound track, and on the 18th of same month the connection was made on the west-bound track. The structure was entirely completed in all its parts on May 1, 1888, although the bridge was opened for travel at an earlier date.

Engineers' Society of Kansas City.

At the meeting of May 20 Mr. Henry Goldmark read a paper on inspection of iron bridges. He referred to the lead taken by the Kansas City club in highway bridge reform, but considered the safety of railroad bridges even of greater importance. While the earlier long span bridges are quite satisfactory, he thought a large proportion of the shorter spans on railroad lines are weak, and referred to the experience of the New York and Massachusetts Railroad Com-

missioners as confirming this. In his opinion the difficulty arises largely from the fact that the bridge designers, as a rule, see little of their work after it goes into use. The remedy pointed out is a systematic inspection by specialists.

The American Institute of Electrical Engineers.

The fifth annual meeting of the American Institute of Electrical Engineers for the election of officers and the transaction of other business was held in this city on May 21. The following officers were elected, who, in addition to those holding over under the rules, will form the board of management until the close of the fiscal year of 1890: President, Prof. Elihu Thomson, of Lynn, Mass.; Vice Presidents, Edward Weston, Newark, N. J.; Prof. E. L. Nichols, of Ithaca, N. Y.; Major O. E. Michaelis, of Augusta, Me.; Dr. Louis Duncan, of Baltimore; Managers, Dr. F. Benedict Herzog, H. C. Townsend, Henry Van Hoevenbergh, of New York, and Prof. Wm. E. Geyer, of Hoboken; Secretary, Ralph W. Pope: Treasurer, Geo. M. Phelps, both of New York. The council reported that there had been a net gain in membership of 60 during the past year. The regular meeting for the presentation and discussion of professional papers was held on May 22. Papers were presented and read in the following order:

"Some Results with Secondary Batteries in Train Lighting," by Alexander S. Brown, of the Pennsylvania Railroad; "The Inherent Defects of Lead Storage Batteries," by Dr. Louis Duncan, Johns Hopkins University; "Motor Regulation," by F. B. Crocker, Instructor in Electrical Engineering, Columbia College; "Magnetism and its Relation to Induced Electromotive Force and Current," by Prof. Elihu Thomson, Lynn, Mass.; "The Relation Between the Initial and the Average Efficiency of Incandescent Lamps," by W. H. Peirce, of the Chicago, Burlington & Quincy Railroad; "The Efficiency of the Arc Lamp," with an introductory note by Prof. E. L. Nichols, by H. Nakano, Cornell University; "The Spiral Coil Voltameter," by H. J. Ryan, Cornell University, and "The Personal Error in Photometry," by Prof. E. L. Nichols, Cornell University. A paper had been announced on the "Measurement of Telephonic Currents," by Prof. Charles R. Cross, of Boston, but owing to his inability to attend, it was omitted from the official programme, and will probably be presented at some subsequent meeting. The closing session of the general meeting took place at the College of the City of New York in the evening of May 22, when Prof. H. A. Rowland, Ph. D., delivered a lecture entitled "Modern Views in Respect to the Nature of Electric Currents." The lecture, which was illustrated by numerous experiments, was listened to with the greatest interest by over 300 persons, among whom were many of the representative electricians of the country.

PERSONAL.

—Mr. Charles P. Hatch has tendered his resignation as General Traffic Manager of the Ohio River road to take effect May 31.

—Mr. F. E Bachman has resigned his position as Manager of the Tennessee Coal, Iron & Railroad Company's furnaces at Ensley, Ala., on account of his health.

—Mr. C. E. Doyle, who has been Superintendent of the Cairo, Vincennes & Chicago road, has resigned that position to become Superintendent of the Pittsburg & Western.

—Mr. Albert B. Corinth, Master Car-Builder of the Georgia division of the East Tennessee, Virginia & Georgia, resigned May 20. The employés of the shops presented him with a handsome gold watch. Mr. Corinth enters the service of the Chicago & Northwestern at Chicago.

ELECTIONS AND APPOINTMENTS.

Black River Falls & Eastern.—The directors are as follows: Hugh H. Price, President, of Black River Falls, Wis.; W. S. Dwinnell, Secretary; D. J. Spaulding, J. W. Cole and W. C. Jones.

Broken Bow & Western.—The officers of this company are: President, John C. Manlick; General Manager, Jesse Gandy, and Chief Engineer, J. W. Matthews. The office is at Broken Bow, Neb.

Chicago & Atlantic.—V. T. Malott, Receiver, has appointed L. G. Cannon General Agent, with headquarters at Chicago.

Chicago, Milwaukee & St. Paul.—E. W. Jordan has been appointed Commercial Agent at Sioux City, Ia., and will have direct supervision of the freight and passenger traffic at that point.

Cleveland & Marietta.—J. I. Kidd, Roadmaster, has been promoted to Engineer and Roadmaster, with office at Cambridge, Ohio.

Concord.—The annual meeting of the stockholders was held in Concord, N. H., this week. The following directors were chosen: Fred Smith, Benjamin A. Kimball and J. H. Pearson, of Concord; W. M. Parker, of Manchester; John A. White, of Concord, and Alpha J. Pillsbury, of Tilton. The directors afterwards organized with F. Smith as President and W. M. Chase as Clerk.

Cumming & Warsaw.—The following are the officers of this company: President, A. T. Abbott, Warsaw, Ga.; Vice-President, L. Edmonson, Cumming, Ga.; Secretary, George L. Bell, Cumming; Treasurer, Ansel Strickland, Cumming.

Flint & Pere Marquette.—At the annual meeting in East Saginaw, Mich., May 15, directors were elected as follows: W. W. Crapo and Loum Snow, of New Bedford, Mass.; Lewis Pierce, of Portland, Me.; George Cappell, of New York; J. W. Mackintosh and F. V. Parker, J. L. Stackpole, of Boston; H. C. Potter, W. L. Webber and H. C. Potter, Jr., of East Saginaw, and W. H. Tansey, of Bay City, the latter taking the place of Alfred M. Hoyt, of New York, who declined a re-election. Officers were chosen as follows: President, W. W. Crapo, Vice-President, H. C. Potter; Secretary and Treasurer, H. C. Potter, Jr.

Goodyear, Neillsville & Northern.—Incorporated in Wisconsin by Darius A. Goodyear, Charles A. Goodyear, Walter D. McPherson, Adam Gobe and Newell Richardson.

Illinois Central.—W. M. Rhett has been appointed First Assistant General Freight Agent of the southern lines, with headquarters at New Orleans, La.

International & Great Northern.—The office of Superintendent of Transportation has been abolished, and T. G. Golden has been appointed Superintendent for the Receivers, with office in Palestine, Tex.

Kearney & Black Hills.—The incorporators of this company are: W. C. Tillson, Finley Burke, E. C. Davidson, J. L. Lombard and E. W. Hazard.

Los Angeles, San Diego & Yuma.—The incorporators are: W. Carlson, Thomas Higgins, F. H. Dixon and H. T. Christian, all of San Diego, where the principal offices will be.

Louisville, Evansville & St. Louis.—The authority of G. J. Grammar, Traffic Manager of the Evansville & Terre Haute road, has been extended over this road.

Manchester & Keene.—At the annual meeting in Nashua, N. H., May 16, officers and directors were elected as follows: W. W. Bailey, President; George C. Lord. James T. Furber, Samuel C. Lawrence, Benjamin Hinckley, C. A. Bartlett, C. H. Burns, Directors; J. W. Fellos, Clerk; C. A. Bartlett, Treasurer.

Marietta & North Georgia.—At the annual meeting of the stockholders, held in Marietta, Ga. May 23, the following directors were elected; Walter G. Oakman and Lenox Smith, of New York; A. L Hartridge, Savannah, Ga.; R. J. Lowry, Atlanta, Ga.; Alexander A. Arthur and Ernest E. Malcolm, Knoxville, Tenn.; J. B. Glover and H. M. Hammett, Marietta, Ga.; E. G. Pierce, Portsmouth, N. H.; J. W. Patton, Murphy, N. C., and Elisha Thayer, Boston, Mass. The following officers were elected: Lenox Smith, Vice-President and Acting President; J. B. Glover, Treasurer, and H. M. Hammett, Secretary.

Marion Belt & Chingawasa Springs.—The following are the officers of this Kansas company: John Hall, President, Fort Ann, N. Y.; Levi Billings, Vice-President, Marion, Kan.; Samuel T. Howe, Treasurer, Topeka, Kan.; C. S. Winslow, Secretary, Marion, and O. C. Leseur, of Marion, Chief Engineer.

Mason City & Fort Dodge.—At a meeting of the stockholders and directors held in Fort Dodge, Ia., May 21, the following officers were elected: Wm. A. Stephens, President, vice C. H. Benedict, resigned; O. C. Burdick, General Manager; S. T. Meservey, Secretary and Treasurer, vice Webb Vincent, resigned, and C. C. Burdick, Assistant Treasurer.

Nashua, Acton & Boston.—The annual meeting was held in Boston, May 22, and the following board of directors was elected: J. C. Moulton, Frederick Smyth, B. A. Kimball, J. H. Pearson, E. H. Spaulding, E. P. Brown, D. R. Marshall, Charles Williams, J. L. Stevens, G. A. Wason, J. M. Fletcher and C. E. York. A meeting of the directors was held immediately after the corporation meeting, and J. C. Moulton was re-elected President, and H. M. Cavis Clerk.

New York & Harlem.—The stockholders, at the annual meeting in New York, May 22, re-elected the old board of directors as follows: Cornelius Vanderbilt, William K. Vanderbilt, Frederick W. Vanderbilt, Samuel F. Barger, Chauncey M. Depew, Charles C. Clarke, John B. Dutcher, John E. Burrill, William H. Leonard, Francis P. Freeman, Samuel D. Babcock, Alfred Van Santvoord and Robert Schell.

Ohio & Mississippi.—F. D. Farrington has been appointed Car Accountant, with office in Cincinnati, in place of C. Kelly, resigned.

Ohio Valley.—F. B. Montgomery has been appointed Traveling Freight and Passenger Agent of the road, with headquarters at Evansville, Ind.

Peterboro.—The annual meeting of the stockholders was held in Nashua, N. H., May 22, and the following officers were chosen: Directors, Edward Spalding, George A. Ramsdell, of Nashua; S. A. B. Abbott, of Boston; Thomas B. Eaton, of Worcester; Virgil O. Gilman, of Nashua; George H. Hall, of Boston; Charles E. A. Bartlett, of Lowell. Clerk, Harry W. Ramsdell, of Nashua; E. Spalding, President; G. C. Shattuck, Treasurer.

Pittsburgh, Beech Creek & Eastern.—The following are the incorporators of this Pennsylvania company, whose incorporation was noted last week: Samuel Nevins, President; C. L. R. Myers, Whitton Evens, Thomas F. Brady, Charles H. Edmunds, Clarence Kennedy and G. Heide Norris.

Pittsburgh & Western.—J. T. Johnson having resigned, C. E. Doyle has been appointed Superintendent, with office in Allegheny, Pa.

Quincy, Omaha & Kansas City.—The directors elected the following officers at a recent meeting in Quincy, Ill.: President, C. H. Bull; Vice President and General Manager, Amos Green; Secretary, Charles Spencer; Treasurer, E. J. Parker.

St. Joseph, St. Louis & Santa Fe.—C. L. Nichols has been appointed Superintendent of this company, with headquarters at Fort Madison, Iowa.

E. G. Nourse has been appointed Assistant Engineer in charge of maintenance of way, with headquarters at Chicago, and will report direct to the General Superintendent.

Cyrus Falconer has been appointed Car Accountant of this company, with headquarters in Rialto Building, Chicago. Appointments take effect June 1.

W. P. Harris having resigned, D. J. Chase has been appointed General Superintendent, to take effect June 1. His headquarters will be at Chicago, Ill.

St. Paul, Glenwood & Northeastern.—The incorporators are H. J. Baldwin, J. E. Glover, William Johnston, Alexander Syme and James Johnson.

OLD AND NEW ROADS.

Alabama, Georgia & Florida.—Articles of incorporation have been filed in Georgia and in Florida. The road is to be built from Columbus, Ga., where it will connect with the Chattanooga, Rome & Columbus and other roads, to a point in Leon or Gadsden County, Fla. C. G. Jordan, of Columbus, is one of the principal projectors.

Astoria & South Coast.—Tracklaying has been begun on that section of the road from Skipanon, opposite Astoria, Ore, southwest to Seaside, on the coast, a distance of 18 miles.

Boothbay & Newcastle.—A survey has just been completed by H. A. Hancox, of Hudson, Mass., for this road from Boothbay Harbor to South Newcastle, Me., to a connection with the Knox & Lincoln. The distance is 12½ miles, and the character of the work light, with easy grades and alignment. The road will pass through the towns of Newcastle, Edgecombe and Boothbay to a terminus at Boothbay Harbor, which offers one of the finest shipping harbors on the coast. The prospective business will be largely summer travel, as Squirrel Island and many other pleasant and thriving summer resorts are situated in the vicinity.

Broken Bow & Western.—This company is having a preliminary survey made for its road which it is proposed to build from Arcadia, Neb, via Broken Bow to North Platte and west. On the first 60 miles the survey is finished, but no right of way has been secured.

Canadian Pacific.—Bids have been received for grading the proposed line from Missouri Station, a point 27 miles east of Vancouver, south to the international line, to a connection with a line to be built by the Seattle, Lake Shore & Eastern. The branch to be built by the Canadian Pacific will be 10 miles long. The line of the Seattle, Lake Shore & Eastern is now completed for 6 miles north of Snohomish, Wash. Ter., and the surveys now in progress from this point to the proposed connection with the Canadian Pacific.

Cleveland, Columbus, Cincinnati & Indianapolis.—Argument was heard last week at Cleveland in the suit of Judge Burke to prevent the consolidation of this road with the Cincinnati, Indianapolis, St. Louis & Chicago. The counsel for the company laid stress on the opposition to the claim that the two lines of railroad cannot be considered parallel lines. He expressed surprise at a claim attributed to the complainant to the effect that the act of consolidation must be controlled by the act in force when the company was organized and not when the proposition to consolidate comes up. He pointed out that the constitution says that all laws with regard to corporations are subject to change. This provision goes into the charter of every corporation. The consolidation proposes to organize a new company under the law and get its power from the law. The agreement to consolidate constitutes a charter. The amount of capital stock is agreed upon and its franchise is derived through the agreement. The argument in favor of the additional issue of stock is the difference in the value of the shares of the two companies. The object of giving a veto power to the preferred stockholders is to prevent anything which will increase the fixed charges, mortgaging the road to make improvements. Nobody in either of the companies voted to buy the Cairo, Vincennes & Chicago road. There is simply an understanding that the veto power of the preferred stockholders will not stand in the way of the purchase." The hearing of arguments on both sides consumed several days, and at the end of the hearing the matter was taken under advisement. A decision is expected next week. The case will probably be taken to a higher court by the party decided against in the present suit.

Columbus, Brownstown & New Albany.—A company of this name is being organized at Columbus, Ind., to build a road from that point southwest to Brownstown, 20 miles. A company called the Columbus & Indianapolis will also be formed to continue the line to Indianapolis. It is thought that the project is in the interest of the Louisville, New Albany and Chicago, which is credited with the intention of forming a new line from Indianapolis to Chicago.

Covington & Macon.—The survey for the branch from near Monticello on the main line, west to Griffin, Ga., has been completed to Indian Spring and will soon reach Griffin.

Cumming & Warsaw.—It is claimed that contracts will soon be let for building this road, which is projected to extend from Cumming to Warsaw, Ga., about 20 miles. A. T. Abbott, of Warsaw, is President, and George L. Bell, of Cumming, is Secretary.

Decatur, Chesapeake & New Orleans.—Forrest & Co., of Memphis, have been awarded a contract for building from Shelbyville, Tenn., south to the Alabama line.

Deer Creek & Susquehanna.—Work on this road, an extension of the Maryland Central, from Belair to Stafford, 16 miles, that was suspended last month, has been resumed by the contractors, McCabe & Bro., between Priestford Bridge and Stafford, and work will now be pushed as fast as possible.

Denver, South Park & Pacific.—Decrees of foreclosure and sale were issued last week in the United States Circuit Court at Denver, in the suits of the Central Trust Co., of New York, trustee, and the Farmers' Loan & Trust Co., trustee, against this company. The complaint in the case was filed on Nov. 12, 1888. The foreclosure is on mortgage bonds given by the company in August, 1876, amounting to over $2,000,000.

Dravosburg, Reynoldston & McKeesport.—Chartered in Pennsylvania to build a road three miles long near McKeesport, Pa., for passenger traffic. Thomas Reynolds, of McKeesport is President.

East Carolina Land & Railway Co.—Surveys will be commenced about Sept. 1 by this company for a road 90 miles long, from New Berne, N. C., via Jacksonville to Wilmington, passing through a timbered country and through the White Oak Swamp, which land will be transferred to the company by the state as soon as the road is finished across it The company has also secured local aid to the extent of $80,000. C. E. Foy, of New Berne, is President.

East & West of Alabama.—Mention was made last week of the fact that this road was being made standard gauge, and that an extension was under consideration. The survey for the extension is about to be started, the objective point being Birmingham. The Receiver recently received authority to issue Receiver's certificates to make the road a standard gauge, and with that view is preparing plans and specifications. There will be a large number of iron bridges to build and some grading to relieve the line of a heavy grade at one point. The contract for the work has not yet been let. The United States Circuit Court for the Southern Division of the Northern District of Alabama issued on April 6 authority to the Receiver to issue $400,000 of Receiver's certificates, reserving the right to increase this to $650,000, if necessary. The fund obtained will be used to change the road to standard gauge and to fully reconstruct and repair it. Four hundred thousand dollars of the certificates have been placed at par in New York City.

Flint & Pere Marquette.—The President has issued a circular giving notice that the company having acquired by purchase the railroad and property of the Port Huron & Northwestern Railway Co., and assumed control April 1, connecting lines are requested to communicate with the various departments of the Flint & Pere Marquette in matters pertaining to traffic, and the general operations of the Port Huron & Northwestern originating since April 1.

Florida.—Bills have been introduced in the legislature to incorporate the West Florida & Alabama and the Brooksville & Lacoochee railroad companies.

Goodyear, Neillsville & Northern.—Incorporated in Wisconsin to build a road from a point near Goodyear Station, Jackson County, on the Chicago, Milwaukee & St. Paul, to Neillsville, Clark County, about 25 miles. The capital stock is $200,000.

Fort Payne Coal & Iron Co.—Allison, Shafer & Co., of St. Louis, have the contract to build a steam railroad from Fort Payne, Ala., to the mines of the company, about 8 miles distant from the town. Work on the road will begin this week, and will be finished by October. It is probable that the road after its completion will be turned over to a railroad corporation and form a link in an east and west road. Already advances have been made the company by different railroad men to take the line.

Georges Valley.—Henry A. Hancox, of Hudson, Mass., has made several reconnoisances for this line, and meetings in the interest of the project are being held in the town through which it is proposed to build it. It is estimated that the road can be built for $9,000 a mile, using 56-lb. rails, with a maximum grade of 80 ft. per mile and a maximum curva-

ture of 6°, land damages not included in the estimate. It is proposed to build the line from Union through South Union and Warren, Me., to a connection with the Knox & Lincoln near Warren Station. It is expected it will do a large local business in the transportation of lime to Rockland and marketing agricultural products from the flourishing towns to the north of Union, whose business will centre there. The length of the proposed road from Union to a connection with the Knox & Lincoln is approximately 8 miles, but the road is destined to be extended up the Georges Valley through the towns of Washington and Liberty to Belfast and a connection with the Maine Central. The National Construction Co., 2 Wall street, New York, has proposed to build the road from Warren to Union and have it in operation by Oct. 1, for $5,000 per mile in cash, $5,000 per mile in bonds, $5,000 per mile in stock.

Kearney & Black Hills.—Charter filed in Nebraska to build from the city of Kearney northwest through the counties of Buffalo, Dawson, Custer, Logan, McPherson, Grant, Sheridan, Box Butte, Dawes and Sioux to some point on the northern boundary line of the state. Branch lines are to run as follows: From Kearney to a point in Adams county, and from Kearney through the counties of Buffalo, Dawson and Custer to Broken Bow. The capital stock is placed at $5,000,000.

Kentucky Union.—The following contracts have been recently let: To Munday & Co., three miles; to Stark, Johnson & Co., two miles; to Mason & Locker, three miles; and several miles to Mason & Woolfolk.

Knoxville, Cumberland Gap & Louisville.—W. T. Burgin has been awarded a contract for three miles near Knoxville. Tracklaying on the road has been completed for about 40 miles from Knoxville.

Los Angeles, San Diego & Yuma.—Charter filed in California to build a road from Los Angeles to Yuma, Ariz., with principal office in San Diego.

Louisville & Nashville.—Citizens of Clarksville, Tenn., are making an effort to secure a branch of the Louisville & Nashville from Clarksville to Dickson. This would give another and shorter connection between Clarksville and Nashville. The matter is to be brought before the directors in the fall.

Marion Belt & Chingawasa Springs.—N. S. Woods, of Wichita, Kan., who has the contract for building the eight miles of this road from Marion to Chingawasa Springs, Kan., expects to have the road completed by August. The line is being built as a standard gauge, with 35-lb. rails, and, when it is finished, Chingawasa Park, which contains many springs, will be improved by the company and made a summer resort. Extensive stone quarries near Chingawasa will also be opened. Both the park and the quarries are owned by the company. About 3½ miles of the line is in Marion, Kan. O. C. Leseur, of Marion, is Chief Engineer.

Mason City & Fort Dodge.—Action has been begun at Fort Dodge, Iowa, in the District Court, by the Minneapolis & St. Louis to prevent the collection of the tax voted to aid the building of the Mason City & Fort Dodge road. The petition alleges that the road was built simply for speculation, the expense of building being only $900,000 which was almost wholly covered by special taxes, and that bonds to the amount of $1,400,000 were floated after the taxes were voted.

Memphis & Charleston.—The Supreme Court of Alabama this week heard arguments upon the appeal taken by the East Tennessee, Virginia & Georgia from the decision of Chancellor Cobbs recently rendered in a suit brought by minority stockholders of the company to prevent the East Tennessee, Virginia & Georgia from voting upon its holding of the majority of the stock of the Memphis & Charleston. Chancellor Cobbs held that the acquisition of the stock by the East Tennessee was illegal because one corporation cannot lawfully purchase the stock of another unless specially authorized and that it should not be permitted to vote upon the stock thus acquired and thereby control the management of the Memphis & Charleston. At the conclusion of the arguments the Supreme Court took the case under advisement.

Mount Jewett, Kinzua & Riterville.—The survey has been made from Mount Jewett, Pa., to Kinzua Creek, about three miles, and will soon be finished to the connection with the New York, Lake Erie & Western, near Crawford's Summit, about eight miles from Mount Jewett. The right of way has been obtained and it is expected to commence track laying early in June, opening the road for traffic in July. The company's forces will do the work. The grade and cross-ties will be for a standard gauge road, but at present 30-lb. rails will be used and the gauge made 3 ft. E. K. Kane, of Kane, Pa., is president, and G. H. Lyon, of Bradford, is Chief Engineer.

New Orleans, Fort Jackson & Grand Isle.—The preliminary surveys from New Orleans to Fort Jackson, about 60 miles, have been made, and right of way is being secured. The company has secured about $200,000 in subscriptions. P. S. Lawton, of Algiers, La., is one of the projectors.

New Roads.—A company is being organized to build a road from a point on the Pensacola & Atlantic to Apalachicola, Fla., via St. Andrews and St. Joseph.

New York & Greenwood Lake.—Surveys have been made by this company at Orange, N. J., beginning at the terminus of the road at Main street, and making a loop around all the Oranges, connecting again with the Watchung road at Watcessing. Surveys and estimates have been completed, and are now in the hands of the projectors of the scheme, for consideration.

New York, Lake Erie & Western.—Following is the report of the operations and expenses of the company for the month of April, 1889, and for the seven months to April 30, as compared with the same period last year.

Month of April.	1889.	1888.	Dec.
Gross earnings	$1,953,733	$2,112,656	$158,923
Working expenses	1,329,237	1,395,531	66,294
	$624,496	$717,125	$92,629
Less due to leased lines	174,908	184,378	9,470
Net earnings	$449,588	$532,747	$83,159
Seven months to April 30.	1889.	1888.	Dec.
Gross earnings	$14,666,809	$15,354,592	$687,783
Oper. expenses	9,655,549	10,158,051	502,492
	$5,011,250	$5,196,541	$185,291
Less due leased lines	1,316,671	1,352,186	35,515
Net earnings	$3,694,579	$3,844,355	$149,776

Northern Pacific & Manitoba.—The contract for 50 miles of the branch from Morris to Brandon, Man., were let May 18, as follows: Egan Bros., 15 miles; Mann Bros., 10 miles; J. D. McArthur, 10 miles; Dennison, 5 miles; Erwin & McNeary, 5 miles; M. McCrimmon, 5 miles. The 50 miles that the contracts have been let for begin at the end of the 20 miles now graded westward from Morris. The balance of the work will be let by the time the 50 miles are completed. The lowest tender submitted was 7 cents per yard, and the highest 28 cents. The others ranged from 13 to 17 cents. Fifteen miles of mountain work, the heaviest on the line, will be done for 15 cents per yard.

Pennsylvania.—The statement of the business of all lines east of Pittsburgh and Erie for April, 1889, as compared with the same month in 1888, shows an increase in gross earnings of $382,324, an increase in expenses of $248,344 and an increase in net earnings of $133,980. The four months of 1889, as compared with the same period of 1888, show an increase in gross earnings of $1,028,363, an increase in expenses of $687,865 and an increase in net earnings of $340,498. All lines west of Pittsburgh and Erie for the four months of 1889 show a deficiency in meeting all liabilities of $141,047, being a gain as compared with the same period of 1888 of $4,672.

Philadelphia & Reading.—The following is a statement of the operation of the railroad for the month of April, 1889, as compared with the same month of 1888:

	1889.	1888.	Inc. or Dec.	
Gross receipts	$1,381,525	$1,706,291	D.	$324,766
Expenes (excluding rent and interest)	878,568	885,800	D.	7,232
Net earnings	502,957	820,491	D.	317,534
Net earnings from Dec. 1 to date	2,577,645	2,519,039	I.	58,607

Point Pleasant, Adelphi & Northwestern.—It is stated that surveys will begin at once on this road, which is projected to extend from Adelphi, O., southeast through the Hocking Valley to a point in Meigs County. E. P. Buell, of Adelphi, is one of the projectors.

Port Townsend Southern.—The locating survey is now completed for the section between the 6th and 36th miles from Port Townsend, N.T., and it is expected to let the contract in July. Payne Bros., of Port Townsend, have the contract for the first 6 miles. The preliminary work on the line is generally complete, although the company expects to keep a party in the Chehalis Valley region for a month or two on preliminary work. The following is the route of the road: From Port Townsend to Discovery Bay, thence via Leland Valley to Quilcene on Hood's Canal, thence along the west shore of the canal to Union City, thence to the head waters of the Satsop River, thence down the Satsop to Chehalis Valley, thence to a connection with the Pacific Division of the Northern Pacific. J. B. Hoggs is Chief Engineer, with office in Port Townsend.

Redondo Beach.—About 8 miles of grading on this narrow gauge road is now completed, and the entire 20 miles from Los Angeles to Redondo Beach, a summer ocean beach resort, will be completed by July 15. George J. Ainsworth, of Los Angeles, is President.

Richmond, Nicholsville, Irvine & Beattyville.—D. Shannon & Co., who have the contract for building this road, have between 1,100 and 1,300 men at work on the grading and tunneling, besides a large force building trestles and other work. The construction work is being pushed with great rapidity, and at the present rate of progress, it will be completed much before the time specified in the contract. Tracklaying will begin in July at Nicholsville. The Ohio Valley Improvement & Contract Co. is building the line. J. H. Pearson is Chief Engineer for the railroad company, and C. F. Rock for the construction company.

Richmond & West Point Terminal Co.—Bankers offer for sale $5,000,000 of the company's five per cent. consolidated first mortgage collateral trust gold bonds. These bonds are issued on a total mortgage of $24,300,000, of which the Central Trust Co., of New York, is trustee. The bonds bear the date of March 1, and the interest is payable half yearly in gold. The bonds referred to constitute a first lien on certain stocks and bonds (particularly enumerated in the mortgage) having a market value of $7,460,000, but for purposes of control are valued at $7,540,600. The estimated revenue of the railroads controlled by this company for 1889 will be more than $1,100,000.

Rochester, Rensselaer & St. Louis.—This company proposes to build a road from Rochester, Fulton County, Ind., to Gilman, Iroquois county, Ill., and is filing for record a mortgage to secure an issue of bonds to the amount of $2,000,000. John K. Lee is President.

St. Louis & Peoria.—Herr Bros. of Litchfield, Ill., have the contract for grading this new road from Mt. Olive to Alhambra, Ill., 14 miles. They have commenced work, and expect to have this section finished August 1. The right of way has been secured. The line between East St. Louis and Peoria, about 86 miles, is under survey. D. L. Wing, of Springfield, Ill., President of the St. Louis and Chicago, is also President of this company.

St. Paul, Glenwood & Northeastern.—Incorporated in Wisconsin to build a road from Glenwood, St. Croix County, to Ashland. The capital stock is $1,500,000.

Southern Pacific.—On the southern end of the coast division locating surveys have been made from Elwood, Cal., north for 21 miles, and three preliminary surveys have been made from this point to San Luis Obispo, about 70 miles. The northern end of this division is in operation to Santa Margarita; the locating survey has been finished south to San Luis Obispo, and construction will commence as soon as the right of way is secured. In the San Joaquin Valley a definite location has been made for the new line from Oakdale to Sanger, 100 miles. From Oakdale it will skirt the eastern foot-hills of the valley, and run into Merced, connecting with the main line. From Merced the route will be to the eastern foot-hills and south to Sanger, 14 miles east of Fresno, where connection will be made with the Fresno branch line. The Fresno branch line is completed between Fresno and Poso, 105 miles, but at present is operated only as far as Porterville. It will be in operation to Poso within two months. On the western side of the San Joaquin track has been laid for some time between Tracy and Newman. From Newman to Armona, 105 miles, the roadbed is ready for tracklaying. The branch connects at Tracy with the main line and at Armona with the Huron branch.

Toledo, Columbus & Cincinnati.—The special master has given the deed of the property of the Toledo, Columbus & Southern to the incorporators of this company, who purchased the road at foreclosure sale. The articles of incorporation have been filed in Ohio.

Toledo & Western.—Chartered in Ohio by Frank B. Swayne, Noah H. Swayne, Harry E. King and Frank A. Clay and others to build a road from Toledo west to the Indiana state line.

Wheeling & Lake Erie.—Tracklaying is now in progress on the section from Bowerstown east to Scio, Harrison County, O., about 10 miles. F. W. Jones, of Mount Vernon, the contractor for the grading, has finished his work, which was heavy, there being a number of rock cuts from 800 ft. to 1,300 ft. long and from 30 ft. to 40 ft. deep.

TRAFFIC.

Traffic Notes.

The Canadian Pacific has applied to the secretary of the Treasury to be bonded as a common carrier between ports of the United States.

Nearly 900,000 tons of ore have been shipped from the Lake Superior region since the opening of navigation a month ago.

The Chicago roads have agreed to discontinue the opening of their outside ticket offices in that city on Sunday. These offices, of which there are 25, have heretofore been kept open from 10 a. m. to 12 noon on that day.

The Housatonic road, whose wharves and buildings at Wilson's Point, the southern terminus of the Danbury & Norwalk Division, were burned last week, is now sending its New York City freight by boat from Bridgeport.

The Toledo, St. Louis & Kansas City is demanding a differential rate on grain and flour from St. Louis eastward, and it is reported that some roads have already made a rate of 23 cents to New York. The all rail rate from Chicago is still 25 cents.

Chairman Midgley has issued a circular notifying the Southwestern roads that grain stopped at the Missouri River for milling in transit may be held for any period less than six months. There is an agreement that grain shall not be held over thirty days, but it is learned that the Missouri Pacific has habitually disregarded it.

General Manager Towne, of the Southern Pacific, in testifying before the Senate Committee on relations with Canada at its inquiry in San Francisco said, that by reason of the diversion of Asiatic traffic by the Canadian Pacific steamers the Southern Pacific in 1888 lost $660,000 in carrying tea and $46,000 in raw silk shipments, and that about 80 per cent. of all the cotton goods exported from the eastern states to China in that year were shipped by the Canadian Pacific. The Canadian Pacific in six months carried 10,400 through passengers to and from the principal cities of the Pacific coast.

The Union Pacific has created considerable stir at Denver by imposing a charge of $3 per car for switching ore and bullion coming from other roads for delivery in that city. It appears that this traffic, of which there is a large amount in that city, has to be handled almost wholly on Union Pacific tracks, although being brought in by all of the roads and has heretofore been switched free or at a nominal charge. Business was almost at a standstill for a short time, and the difficulty was still unsettled at last accounts, though it appears that the competitors of the Union Pacific will probably absorb the switching charge to hold the traffic of their customers.

The question of live stock traffic between Missouri River points and Chicago is still attracting a good deal of attention, and Chairman Walker, of the Inter-state Commerce Railway Association, has under consideration a complaint made by the Chicago & Alton, in which the demand is made that the Association take measures to secure a more equitable distribution of this traffic from Kansas City. It appears that for several weeks the Chicago, Milwaukee & St. Paul, which is the longest line from Kansas City to Chicago, has taken a large share of the business, having delivered 407 cars in Chicago since May 1, while the Alton, a much older and a more direct line, has delivered only 137 cars.

Chairman Blanchard, of the Central Traffic Association, has issued a circular asking co-operation from the roads in the association in carrying out the request presented by the St. Louis, Iron Mountain & Southern, the Mobile & Ohio and the St. Louis, Alton & Terre Haute companies looking to the prevention of scalping. Tickets are being sold from Buffalo, New York, Washington and other points reading *via* St. Louis to Cairo, Memphis and other points on the east of the Mississippi River south of St. Louis, with sufficient limit to permit extensive scalping both east and south of St. Louis. It is requested that all such tickets be limited to continuous passage, and in no case exceeding one day's time south of St. Louis.

Interstate-Commerce Commission.

The Commission began in Chicago, May 27, a hearing on the complaint of the Chicago Board of Trade, charging the roads between Missouri River points and Chicago with discrimination in charging upon live hogs a higher rate (25c.) than that on pork, lard and other hog products (20c.). The commission decided to also hear at the same time the complaint of John P. Squire & Co., of East Cambridge, Mass., against the lines between Chicago and New York and Boston, for unfair discrimination during the rate war of last year. Squire & Co. received live hogs in large quantities from the West, and now allege heavy damages because the rates, not only on hogs but on other live stock and on dressed meats, was reduced disproportionately on shipments to New York as compared with the prices to Boston and East Cambridge, which were more nearly maintained. The Chicago-Missouri River railroads are said to be unable to decide upon an adjustment of rates which will be equitable as between the Chicago packers and those who pack at Missouri River points, and consequently they do not takes sides in this controversy. The case has therefore resolved itself into a contest before the commission between the rival packers. The principal evidence and arguments thus far presented are based on the percentages which have heretofore been decided to be equitable as between live animals and dressed meats. The relative rates on cattle and dressed beef in refrigerator cars between Chicago and the seaboard was decided several years ago by a special arbitration committee, of which Judge Cooley was a member, and the pork packers seek to apply the principles of that case to the facts now in question.

The commission held a hearing at Toledo, O., last week, on the complaint of the Toledo, Detroit, Cleveland and Buffalo Produce Exchanges, against the Michigan Central, Lake Shore, New York Central and Boston & Albany, for discrimination in charging 5 cents per 100 lbs. more on grain for home consumption than on that for export via Boston.

Discrimination.

The New York Railroad Commissioners have issued a decision on the complaint of the Buffalo Merchants Exchange in which the railroads are accused of discriminating against that city in making rates from the West to the East, as, for instance, fixing that from Chicago to New York or Boston, lower than the sum of those from Chicago to Buffalo and Buffalo to the seaboard. The Board recommends that the New York Central & Hudson River cease the discrimination alleged in favor of certain firms in Rochester and Buffalo, and charge all firms the published prices. The Board says the railroads should consider the propriety of charging no more upon freight from Buffalo to Eastern points than a pro rata share of the through rates from Western points to Eastern points. This principle should be observed, even if it should result in higher charges from Western to Eastern points and the seaboard, otherwise the result will be that the centres of business and distribution will be pushed further and further west, to the detriment and eventual paralysis of Eastern cities.